

DISTRIBUTION STATEMENT A
Approved for Public Release
Distribution Unlimited

A Concise History of the U.S. Air Force

Stephen L. McFarland

Air Force History and Museums Program

1997

20050429 021

A Concise History of the U.S. Air Force

Except in a few instances, since World War II no American soldier or sailor has been attacked by enemy air power. Conversely, no enemy soldier or sailor has acted in combat without being attacked or at least threatened by American air power. Aviators have brought the air weapon to bear against enemies while denying them the same prerogative. This is the legacy of the U.S. Air Force, purchased at great cost in both human and material resources.

More often than not, aerial pioneers had to fight technological ignorance, bureaucratic opposition, public apathy, and disagreement over purpose. Every step in the evolution of air power led into new and untrodden territory, driven by humanitarian impulses; by the search for higher, faster, and farther flight; or by the conviction that the air way was the best way. Warriors have always coveted the high ground. If technology permitted them to reach it, men, women and an air force held and exploited it—from Thomas Selfridge, first among so many who gave that “last full measure of devotion”; to Women’s Airforce Service Pilot Ann Baumgartner, who broke social barriers to become the first American woman to pilot a jet; to Benjamin Davis, who broke racial barriers to become the first African American to command a flying group; to Chuck Yeager, a one-time non-commissioned flight officer who was the first to exceed the speed of sound; to John Levitow, who earned the Medal of Honor by throwing himself over a live flare to save his gunship crew; to John Warden, who began a revolution in air power thought and strategy that was put to spectacular use in the Gulf War.

Industrialization has brought total war and air power has brought the means to overfly an enemy’s defenses and attack its sources of power directly. Americans have perceived air power from the start as a more efficient means of waging war and as a symbol of the nation’s commitment to technology to master challenges, minimize casualties, and defeat adversaries.

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

The public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing the burden, to Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports (0704-0188), 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.

PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS.

1. REPORT DATE (DD-MM-YYYY) 1997		2. REPORT TYPE na/		3. DATES COVERED (From - To)	
4. TITLE AND SUBTITLE A Concise History of the U.S. Air Force				5a. CONTRACT NUMBER n/a	
				5b. GRANT NUMBER n/a	
				5c. PROGRAM ELEMENT NUMBER n/a	
6. AUTHOR(S) McFarland, Stephen L.				5d. PROJECT NUMBER n/a	
				5e. TASK NUMBER n/a	
				5f. WORK UNIT NUMBER n/a	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Air Force History Support Office 3 Brookley Avenue Box 94 Bolling AFB DC 20032-5000				8. PERFORMING ORGANIZATION REPORT NUMBER n/a	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) n/a				10. SPONSOR/MONITOR'S ACRONYM(S) n/a	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S) n/a	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution is unlimited.					
13. SUPPLEMENTARY NOTES n/a					
14. ABSTRACT Provides a short history of military air power in the United States from the Civil War to the Gulf War. 84 pp., photos, suggested readings GPO Stock No.008-070-00727-4 ISBN: 0-16-049208-4					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT UU	18. NUMBER OF PAGES 84	19a. NAME OF RESPONSIBLE PERSON Richard I. Wolf
a. REPORT U	b. ABSTRACT U	c. THIS PAGE U			19b. TELEPHONE NUMBER (Include area code) 202-404-2186

Standard Form 298 (Rev. 8/98)
Prescribed by ANSI Std. Z39.18

Contents

The Genesis of American Air Power	1
Trial and Error in World War I	4
Interwar Doctrine, Organization, and Technology	11
World War II—Global Conflict	21
Air Power in the Nuclear Age	40
Limited War in Korea	45
The “New Look” Air Force	51
Flexible Response and Vietnam	57
The Cold War Concluded	69
Air Power Triumphant—The Gulf War	75
The Future	81
Suggested Readings	83

For sale by the U.S. Government Printing Office
Superintendent of Documents, Mail Stop: SSOP, Washington, DC 20402-9328
ISBN 0-16-049208-4

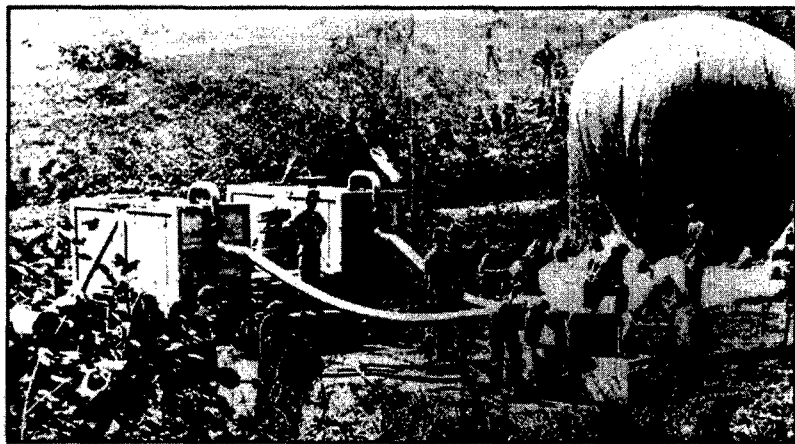
They shall mount up with wings as eagles.

—Isaiah 40:31

The Genesis of American Air Power

Americans took to the skies at an early date. Benjamin Franklin considered the possibility of using balloons in warfare in 1783, only days after the first successful hot-air balloon flights in France. John Sherburne, frustrated by the Army's ineffectiveness during the Seminole War of 1840, proposed using balloons for observation above the wilderness that hid the adversary. John Wise, dismayed by the prospects of a long and costly siege of Veracruz during the Mexican War, suggested using balloons in 1846 for bombing defending forces, three years before Austria actually did so against Venice.

John LaMountain and Thaddeus Lowe successfully launched manned reconnaissance balloons in support of Union operations during the American Civil War. In late June 1861 Lowe's map of Confederate positions in Falls Church, Virginia, was the first significant contribution of manned flight to American warfare, although the Union lost the battle at Bull Run in July. The map allowed Lowe to report after the battle that the Confederates were not advancing on Washington. He was thus able to help prevent panic following the defeat. In September he demonstrated the balloon's potential when he directed artillery fire at Confederate posi-

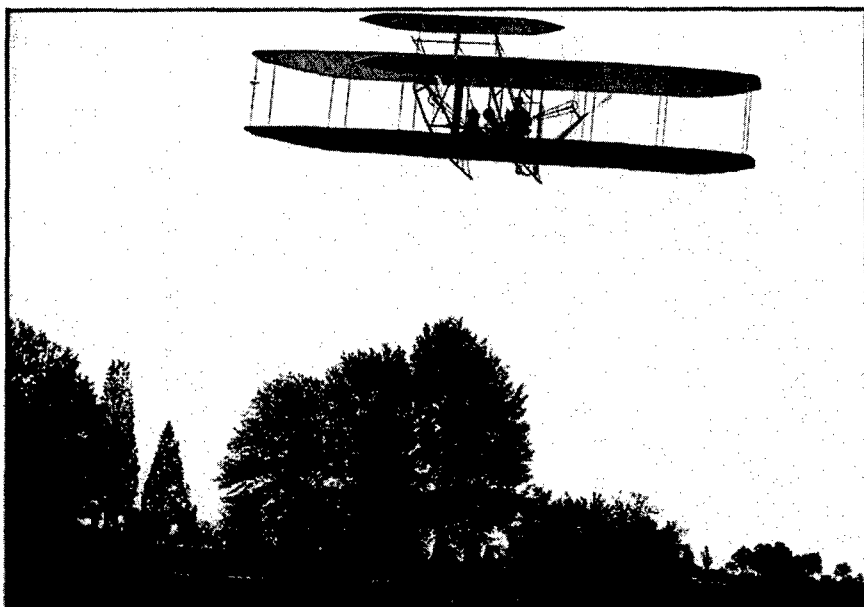


By means of such balloons as the *Intrepid*, shown being inflated during the Civil War battle at Fair Oaks outside Richmond, Virginia, in the spring of 1862, the Union Army conducted reconnaissance missions over enemy territory in America's first use of air power.

tions. He went on to establish the first U.S. "air force," the Balloon Service of the Army of the Potomac, although weather, technological limitations, bungling, and military opposition prevented further development and exploitation.

His Civil War experience convinced Brigadier General Adolphus Greely of the Army Signal Corps that the balloon's capabilities had been unrealized. As part of a special section formed in 1892, his one balloon directed artillery fire during the Battle of San Juan Hill in the Spanish-American War and reported the presence of the Spanish fleet at Santiago de Cuba Harbor. This limited success with lighter-than-air balloons (enemy ground fire destroyed the section's balloon in Cuba) encouraged Greely and the Army to give Samuel Langley, Secretary of the Smithsonian Institution, \$50,000 in 1898 to build a powered heavier-than-air flying machine. The spectacular failures of Langley's Aerodrome launched over the Potomac River on October 7 and December 8, 1903, soured Army opinions on the practicality of flight for several years. When Orville and Wilbur Wright succeeded in the world's first powered, heavier-than-air, controlled flight on December 17, 1903, the Signal Corps expressed no interest. Establishing the Aeronautical Division of the Signal Corps on August 1, 1907, the Army ignored the Wrights and their achievement. It preferred experimenting with the steerable airship or dirigible, then being perfected in Europe. The desertion of a private cost the Aeronautical Division half of its enlisted strength, but did not prevent the Army from ordering its first nontethered airship, Dirigible No. 1, for \$6,750 in 1908.

The Wrights' successes came to the attention of others, however, and President Theodore Roosevelt directed the Army to entertain bids for an aircraft in late 1907. Meanwhile, intrepid airmen pressed on. Lieutenant Frank Lahm became the first officer to fly in an aircraft in early September 1908. Not even the death of Lieutenant Thomas Selfridge, America's first military aviation fatality, killed in what the New York Times called a "wreck of bloodstained wood, wire, and canvas," could stop the advance of military aviation. On August 2, 1909, the Army awarded the Wrights \$30,000 for delivering Aeroplane No. 1, and a \$5,000 bonus for exceeding specifications. The Aeronautical Division now had one aircraft, but no pilots, ground crews, or training establishment. Wilbur Wright taught Lieutenants Frank Lahm, Benjamin Foulois, and Frederic Humphreys to fly. (He included Humphreys as a passenger on the world's first night flight.) Penury soon reduced America's air force to one pilot (Foulois) flying one much-damaged, much-repaired aircraft.



The Wright Military Flyer during flight tests held at Fort Myer in northern Virginia just across the Potomac River from Washington, D.C., 1908. Orville Wright was at the controls. The Flyer is shown over a gate and wall of nearby Arlington National Cemetery.

This was America's air force until Congress approved \$125,000 in 1911 for its expansion, despite the objection of one member: "Why all this fuss about airplanes for the Army? I thought we already had one." In Wright and Curtiss aircraft early Army flyers began stretching aviation's limits with bomb-dropping, photography, and strafing while forming their first unit, the 1st Aero Squadron, on December 8, 1913. These achievements convinced Congress to give the Army's air force official status on July 18, 1914 as the Aviation Section, Signal Corps, which absorbed the Aeronautical Division and its 19 officers, 101 enlisted men, 1 squadron, and 6 combat aircraft.

Orville Wright's first flight in 1903 had lasted twelve seconds; by 1916 flights of four-hours duration had become possible. This progress was soon tested. Brigadier General John Pershing pursued Pancho Villa in Mexico from 1916 to 1917 to bring the Mexican revolutionary to justice for attacking an American border town, Columbus, New Mexico. Captain Benjamin Foulois, with ten pilots and eight aircraft of the 1st Aero Squadron, struggled against winds, storms, and high mountains to locate Villa; but a series of disasters, some comic, some tragic, stood in

vivid contrast to aerial achievements on the Western Front of the Great War in Europe that had begun two years earlier.

Trial and Error in World War I

The potential of the airplane was proved in World War I when its use in critical reconnaissance halted the initial German offensive against Paris. It was not used to harass troops or drop bombs until two months into the war. On the basis of an aviator's report that the German army had a large gap in its lines and was attempting to swing wide and west around the British army, British commander Sir John French refused requests from the French to link up his army with their forces to the east. At the resulting battle of Mons southwest of Brussels on August 23, 1914, the British slowed the overall German advance, forcing it to swing east of Paris. The Allies, on the basis of a British aviator's report of the move, stopped the Germans at the battle of the Marne from September 6 to 9. The Germans, on the basis of one of their aviator's observation of the Allies' concentration, retreated behind the Aisne River. These actions, spurred by aerial observation, forced the combatants into fixed positions and initiated four years of trench warfare.

When American aircrews arrived in France three years later to join the conflict, they found mile after mile of fetid trenches protected by machine guns, barbed wire, and massed artillery. The airplane's primary roles remained reconnaissance and observation over the trenches of both sides, into which were poured men, supplies, and equipment in huge quantities easily seen from the air. Thousands of aviators fought and died for control of the skies above armies locked in death struggles below.

In 1914 the U.S. Army's Aviation Section of the Signal Corps had five air squadrons and three being formed. By April 6, 1917, when the United States declared war on Germany, it had 56 pilots and fewer than 250 aircraft, all obsolete. Congress appropriated \$54.25 million in May and June 1917 for "military aeronautics" to create a total of 13 American squadrons for the war effort. However, French Premier Alexandre Ribot's telegraphed message to President Woodrow Wilson in late May revealed that the United States did not yet comprehend the scale of the war. Ribot recommended that the Allies would need an American air force of 4,500 aircraft, 5,000 pilots, and 50,000 mechanics by 1918 to achieve victory. Trainer aircraft and spare parts would increase America's contribution to over 40,000 aircraft—this from a country that had produced only a few hundred, both civilian and military, from 1903 to 1916.

In the United States an outpouring of patriotism accompanied the declaration of war. Talk of "darkening the skies over Germany with clouds of U.S. aircraft" stiffened Allied resolve. It also appealed to the American people. Congress supported their sentiments when it approved \$640 million on July 24, 1917, the largest lump sum ever appropriated by that body to that time, for a program to raise 354 combat squadrons.

President Wilson immediately created the Aircraft Production Board under Howard Coffin to administer an expansion, but the United States had no aircraft industry, only several shops that hand-built an occasional aircraft, and no body of trained workers. The spruce industry, critical to aircraft construction, attempted to meet the enormous demand under government supervision. A production record that approached a national disaster forced Wilson on May 21, 1918, to establish a Bureau of Aircraft Production under John Ryan and a separate Division of Military Aeronautics under Major General William Kenly. The division would be responsible for training and operations and would replace the Aviation Section of the Signal Corps. Perhaps as an indication of the Army's attitude toward the new air weapon, the two agencies remained without a single overall chief. Not until four months before the end of the war did Wilson appoint Ryan Director of the Air Service and Second Assistant Secretary of War in a late attempt to coordinate the two agencies.

Despite President Wilson's initiatives American aircraft production fell far short of its goals. In June 1917 a mission led by Major Raynal Bolling to investigate conditions on the Western Front, decided that America's greatest contribution to the war besides its airmen would be its raw materials from which the Allies could produce the necessary aircraft in Europe, rather than in the United States. This time-saving approach was not particularly popular, given American chauvinism at the time. The United States would build engines, trainer aircraft, and British-designed DH-4 bombers. It would buy combat aircraft from France (4,881), Britain (258), and Italy (59).

American industry managed to turn out 11,754 aircraft, mostly trainers, before the end of the war—a significant accomplishment. Detroit produced 15,572 Liberty engines, big 12-cylinder in-line liquid-cooled power plants of 400 horsepower that were more efficient than other wartime engines. The Army set up ground schools at 8 universities, 27 primary flying schools in the United States, and 16 advanced training schools in Europe. On Armistice Day the Air Service had 19,189 officers and 178,149 enlisted men filling 185 squadrons.

One of the first American airmen to reach France was Major William "Billy" Mitchell, who studied British and French aerial tech-



A formation of De Havilland DH-4s, British-designed, American-built bombers of World War I.



The most efficient aircraft engine of the war, the American 12-cylinder, 400-horsepower, liquid-cooled Liberty. Standing beside it is Henry H. "Hap" Arnold, future Commanding General, U.S. Army Air Forces (USAAF).

niques and recommended the establishment of two air forces, one to support ground forces and another to launch independent strategic attacks against the sources of German strength. A dearth of aircraft and aircrews prevented the development of the latter effort, and the 1917 Bolling mission had given the idea lowest priority. American Expeditionary Force

commander, General John Pershing, created a divided tactical aerial force, with, first, Brigadier General William Kenly, then Benjamin Foulois, and, finally, Mason Patrick as Chief of Air Service, American Expeditionary Force, and Mitchell as Air Commander, Zone of Advance. A less-than-clear chain of command insured a collision between Foulois and Mitchell, but Pershing wanted Mitchell in charge of combat operations.

Some Americans had already acquired combat experience in France, serving with French and British squadrons before the United States entered the war. Among the most famous were members of the Lafayette Escadrille, including Norman Prince (five victories) and Raoul Lufbery (seventeen victories). These veterans transferred to the Air Service and provided the cadre for new squadrons arriving from the United States. After advanced training, American squadrons joined French and British units for combat experience. Only when American ground units were ready for combat did Air Service squadrons join American armies. Flying French SPAD and Nieuport fighters and French Breguet and British DH-4 bombers, all-American units under American command began operations in March and April 1918. Lieutenants Alan Winslow and Douglas Campbell gained America's first aerial victories on April 14, 1918, in French Nieuport fighters armed with British Vickers machine guns.

The United States may have been slow in developing aerial weapons, but its ground commanders quickly put them to use. Airmen flew infantry contact patrols, attempting to find isolated units and reporting their location and needs to higher headquarters. Of these missions, the 50th Aero Squadron's search for the "Lost Battalion" in the Meuse-Argonne during the offensive of September and October 1918 is perhaps the most famous. Two airmen, pilot Harold Goettler and observer Erwin Bleckley flew several missions at low altitude, purposely attracting German fire to find out at least where the "Lost Battalion" was not. They paid with their lives but helped their squadron narrow its search. For their heroism, Goettler and Bleckley won two of the four Medals of Honor awarded to American airmen during the war. The other two went to Eddie Rickenbacker and Frank Luke for aerial combat.

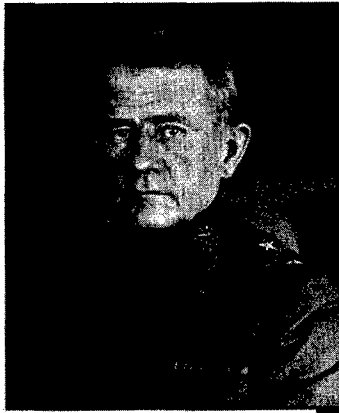
Reconnaissance missions to determine the disposition and make-up of enemy forces were critical and were usually carried out by aircraft flying east at low altitude until shot at. Allied ground troops, for example, needed to know about German activity at the Valleroy railroad yard during the battle of St. Mihiel or, best of all, that the "convoy of enemy horse-drawn vehicles [was] in retreat along the road to Thiaucourt."

World War I Aviation Heroes



Three heroes of World War I: Captain Eddie Rickenbacker; *top, left*, Lieutenant Frank Luke, *top, right*, both recipients of the Congressional Medal of Honor; and the forceful and controversial advocate of air power and service autonomy, Brigadier General Billy Mitchell, *center*, Assistant Chief of Air Service, American Expeditionary Force (AEF).

Early Military Aviation Leaders



The three Chiefs of Air Service, AEF: Major Generals William Kenly, *top, left*, Benjamin Foulois, *top, right*, and Mason Patrick, *bottom, left*. Major General Charles Menoher, *bottom, right*, Chief of Air Service after World War I, set up tactical, training, and engineering centers at Langley, Brooks, Kelly, and McCook Fields.

Airman Gill Wilson wrote spiritedly of such missions in the following lines:

Pilots get the credit
But the gunner rings the bell
When we go to bomb the columns
On the road to Aix-la-Pelle!

The pilots of each side, attempting to prevent their counterparts from conducting tactical reconnaissance, encountered fierce air-to-air combat in aerial "dogfights" that evoked images of medieval warfare and its code of chivalry. The men in the trenches welcomed these solitary knights of the skies who were willing to take on the heavily-defended German observation balloons and their artillery fire aimed at everything that moved. More often than not, life was short in World War I and American aviators lived it valiantly. Frank Luke spent only seventeen days in combat and claimed four aircraft and fourteen balloons, the most dangerous of all aerial targets. Shot down at age 21, he died resisting capture behind German lines. The United States awarded him a Medal of Honor and named an air base after him. Raoul Lufbery claimed seventeen victories before jumping from his own burning aircraft without a parachute. But more died in crashes brought on by malfunctioning aircraft than in combat.

Low-level flight in close support of the infantry was exceedingly dangerous as it involved strafing and bombing over enemy positions. The 96th Aero Squadron flew twelve day bombardment aircraft in three missions against ground targets the first day of the St. Mihiel offensive on September 12, 1918. The next day it mustered only four aircraft ready for duty. Casualty rates of 50 percent or higher were not unusual. When Brigadier General Billy Mitchell had his way, targets were farther to the rear and included rail centers and bridges. One of his officers, Lieutenant Colonel Edgar Gorrell, developed a plan to bomb Germany's "manufacturing centers, commercial centers, and lines of communication." General Pershing approved the plan, but opposition from other ground commanders and insufficient aircraft thwarted America's nascent testing of strategic bombing.

As an American air force, the First Air Brigade (strengthened by French units) in June 1918 fought superior German forces during the battle of Château-Thierry, a bloody initiation to full-scale combat for most American pilots. Mitchell, however, learned the lessons of massing air power in the battle area and of seizing the offensive. This experience

served him well at St. Mihiel in September. With nearly 100 squadrons amounting to 1,500 aircraft under his control, Mitchell organized two forces, one to provide escorted reconnaissance and the other to serve as an independent striking force. With superior numbers, mostly French, Mitchell's airmen seized the initiative, gained air superiority, attacked enemy ground forces, and interdicted supplies flowing to the German front lines. In the final action of the war, during the Meuse-Argonne offensive in September and October, Mitchell concentrated a largely American force to establish air superiority in support of American ground operations.

By Armistice Day on November 11, 1918, the Air Service had prepared and sent 45 squadrons to fight under Mitchell, with 140 more organizing in the United States. In supporting the war the Air Service had about 750 American-piloted aircraft in France, or about 10 percent of all Allied forces. Seventy-one Americans became aces, downing 5 or more enemy aircraft, led by Eddie Rickenbacker with 26 victories. His success paled compared with Manfred von Richthofen's (German) with 80 kills, René Fonck's (French) with 75, and Edward Mannock's (British) with 73, but few claimed as many as quickly as the American. The launching of 150 bombing attacks and the claiming of 756 enemy aircraft and 76 balloons in 7 months of combat and the losses of 289 aircraft, 48 balloons, and 237 crewmen did not turn the tide of war but were portentous of things to come. The airplane had entered combat, and by eliminating the element of surprise through observation and reconnaissance, it had helped Allied forces to victory on the Western Front.

Interwar Doctrine, Organization, and Technology

The scale of destruction and bloodshed in World War I was truly shocking. No one could have imagined 10 million dead and 21 million wounded soldiers or 9 million dead civilians. A generation had been slaughtered in the trenches, the events witnessed by 2 million American servicemen who went home from "over there," convinced that such a war should never be fought again. In its aftermath, diplomats pursued collective security through the League of Nations; the Kellogg-Briand Pact renouncing war as an instrument of national policy; the Locarno Pact recognizing the inviolability of European borders; and the Washington, London, and Geneva disarmament treaties and talks. In Germany airmen sought to restore mobility to the battlefield, joining aircraft and tanks to create *blitzkrieg* warfare. In America airmen strove for the coup de

grace—strategic bombing directly against the vital centers of a nation's war-making capability.

American airmen came back from France with a unique perspective on modern war. Josiah Rowe, of the 147th Aero Squadron, wrote of the World War I battlefield as "a barren waste, broken only by shell holes, trenches and barbed wire, with not one living thing in sight." He was "glad to get away from such gruesome scenes" by climbing into the sky in his airplane. Billy Mitchell wrote that the Allies could cross the front lines "in a few minutes" in their aircraft, whereas "the armies were locked in the struggle, immovable, powerless to advance, for three years . . . It looked as though the war would go on indefinitely until either the airplanes brought [it to an end] or the contending nations dropped from sheer exhaustion."

American airmen knew that aircraft lacked the range, speed, and reliability for strategic bombing, but they had faith that technology could overcome any restrictions. They also knew the importance of concentrating on basic objectives such as winning air superiority or interdicting the front, both of which, they believed, required an independent air force. They had caught tantalizing glimpses of what strategic bombing could do to an enemy's industrial centers. They saw the effectiveness of offense and the futility of defense against a determined aerial assault.

For these and other servicemen, aircraft seemed the answer to the slaughter of trench warfare. German airmen soon envisioned air power as mobile artillery accompanying fast-moving armored units (*blitzkrieg* warfare). American airmen, however, saw air power as an independent strategic force that could bring an enemy nation to its knees. Throughout history, an attacking army fought its way through a defending army to get to its enemy's vital centers. Strategic bombers would fly over the army to strike at the enemy's heart. Air leaders such as Billy Mitchell believed that with aircraft future wars would be shorter and less bloody.

During World War I America's air force had not coalesced. Afterwards it had to be built in an atmosphere of antiwar fervor and congressional stinginess. In addition, the U.S. Army and U.S. Navy, viewing the air force as their auxiliary arms and a supporting weapon, placed obstacles in the way of its further development. The President's Aircraft Board, better known as the Morrow Board for its chairman, the banker Dwight Morrow, called by President Calvin Coolidge in 1925 to evaluate the Air Service's call for independence, reinforced this view: "The next war may well start in the air but in all probability will wind up, as the last war did, in the mud." Evolving technology and irrepressible flyers, however, drove the Air Service in a different direction.

No one in the Air Service was particularly keen on flying close air support in trench warfare. Most airmen thought it unglamorous, marginally effective, and dangerous. What then could air power do, especially with advanced technology? The War Department General Staff already knew what it wanted from its airmen—close air support, reconnaissance, interdiction, and air superiority over the battlefield. The Dickman Board, named for its chairman, Major General Joseph Dickman, appointed in 1919 by General Pershing to evaluate the lessons of the war, concluded: “Nothing so far brought out in the war shows that aerial activities can be carried on, independently of ground forces, to such an extent as to affect materially the conduct of the war as a whole.”

The Air Service could hardly contradict this judgment. Its heavy bomber at the time was the French-built Breguet. A veteran of the Great War with a range of 300 miles and a top speed of 100 miles per hour, it could only carry a 500-pound bomb load. In the postwar demobilization, by 1920 the Air Service was reduced to fewer than 2,200 officers and 8,500 enlisted men. To formulate basic doctrine for the fledgling air force and train officers, Air Service Chief Major General Charles Menoher established the Air Service Tactical School at Langley Field in Virginia, later to become the Air Corps Tactical School at Maxwell Field in Alabama. He made Brooks and Kelly Fields in Texas responsible for flight training and the Engineering Division at McCook Field in Ohio, later to become the Materiel Division at nearby Wright Field, responsible for flight technology. Congress provided the Air Service a measure of independence, changing it from an auxiliary force to an offensive force equal to the artillery and infantry, by creating the U.S. Army Air Corps on July 2, 1926.

Other aerial pioneers sought to test the versatility of aircraft through aerial exploration and discovery in a succession of record-setting flights. In 1921 Lieutenant John Macready climbed to 35,409 feet, higher than anyone before. In 1923 Macready and Lieutenant Oakley Kelly flew a Fokker T-2 nonstop across the width of the United States. In 1924 several Air Service crews led by Major Frederick Martin took 175 days to fly around the world. In 1925 Lieutenants Jimmy Doolittle and Cy Bettis won the Pulitzer and Schneider Cup speed races for the Air Service. Major Carl Spatz (later spelled Spaatz), Captain Ira Eaker, Lieutenant Elwood Quesada, and Sergeant Roy Hooe flew the Fokker trimotor *Question Mark* to a record duration of 150 hours in 1929, displaying the great promise of inflight refueling. Doolittle and Lieutenant Albert Hegenberger achieved what the *New York Times* called the “greatest single step forward in [aerial] safety”—a series of blind flights from

1929 to 1932 that opened the night and clouded skies to flying. Only the Air Corps' assignment to deliver air mail in the first half of 1934, called "legalized murder" by Eddie Rickenbacker because of the 12 lives it claimed, detracted from the image that these aerial pioneers were helping to create.

Record-breaking military flights, alongside trailblazing civilian achievements by Charles Lindbergh and Amelia Earhart, represented the public side of a revolution in aviation technology. The staff at the Engineering Division, and later the Materiel Division, worked with American industry and the National Advisory Committee for Aeronautics (predecessor of the National Air and Space Administration) to develop essential technologies such as sodium-cooled engine valves, high octane gasoline, tetraethyl lead knock suppressants, stressed duraluminum aircraft structures, cantilevered wings, superchargers, turbosuperchargers, retractable landing gear, engine cowlings, radial engines, variable pitch constant speed propellers, and automatic pilots. The two-engine Keystone bomber of the 1920s, a biplane constructed of steel tubes and wires and fabric surfaces, with an open cockpit and fixed landing gear, could fly 98 miles per hour for 350 miles with one ton of bombs. A decade later Boeing's four-engine B-17 bomber could fly nearly 300 miles per hour for 800 miles with over two tons of bombs.

How would America's military aviators use this technology in war? The Army General Staff wanted to employ tactical air power "in



The Air Corps Tactical School at Maxwell Field in Alabama. Air officer training was first established in 1922 at Langley Field in Virginia under the Air Service Field Officers School, later redesignated the Air Service Tactical School.

direct or indirect support of other components of the Nation's armed forces." It believed the primary target was the adversary's army. The most vocal opponent of this view was Assistant Chief of the Air Service, Brigadier General Billy Mitchell, who saw in strategic bombing the proper use of air power. Close air support and interdiction, he asserted, only perpetuated trench warfare and the horrors of World-War I-like slaughter. He argued for a force that could strike directly at an enemy's vitals, "centers of production of all kinds, means of transportation, agricultural areas, ports and shipping," forcing "a decision before the ground troops or sea forces could join in battle."

Mitchell's actions created opponents as well as adherents. A series of highly publicized ship-bombing tests begun in 1921 overshadowed the ideas he had espoused in books such as *Winged Defense: The Development and Possibilities of Modern Air Power—Economic and Military*. Air Service bombers sank several unmanned, anchored ships, including battleships. Mitchell's apparent success, despite poor bombing accuracy, diverted both the public's and the Congress's attention from more critical aerial achievements and issues of the period. Mitchell's troubles with Army and Navy leaders eventually led to his court martial after he spoke intemperately about the crash of the airship *Shenandoah* in 1925. (He blamed the loss on "incompetency, criminal negligence, and almost treasonable administration.") President Coolidge, famous for his reticence and nicknamed "Silent Cal," expressed a widely-held view when he contended, "General Mitchell [has] talked more in the last three months than I [have] in my whole life."

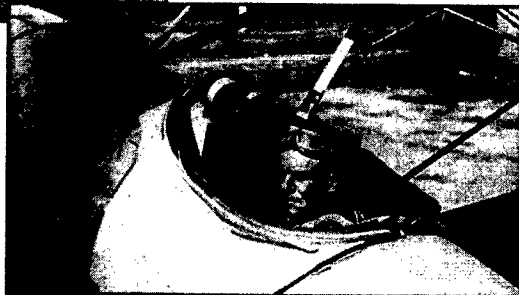
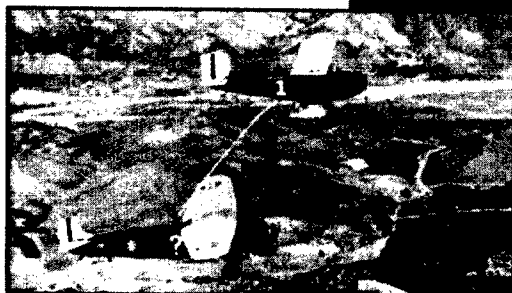
Behind such scenes, Chief of the Air Corps Major General James Fechet urged his officers in 1928 to look beyond the battlefield, beyond close air support, and find a way for the Air Corps to win a war independently. He imposed only three limitations: First, the Air Corps had to get the most for any money available. Second, civilians could not be targets of aerial attack. Secretary of War Newton Baker had ruled earlier that doing so "constituted an abandonment of the time-honored practice among civilized people of restricting bombardment to fortified places or to places from which the civilian population had an opportunity to be removed." Americans would not undertake terror raids, he said, "on the most elemental ethical and humanitarian grounds." Third, anything the Air Corps did would have to solve or avoid the evils of trench warfare.

One officer who answered Fechet's challenge was Lieutenant Kenneth Walker. Conventional wisdom taught that while airmen achieved high accuracy when they bombed from high altitudes, they exposed themselves to deadly ground fire. Walker showed that daylight high-altitude

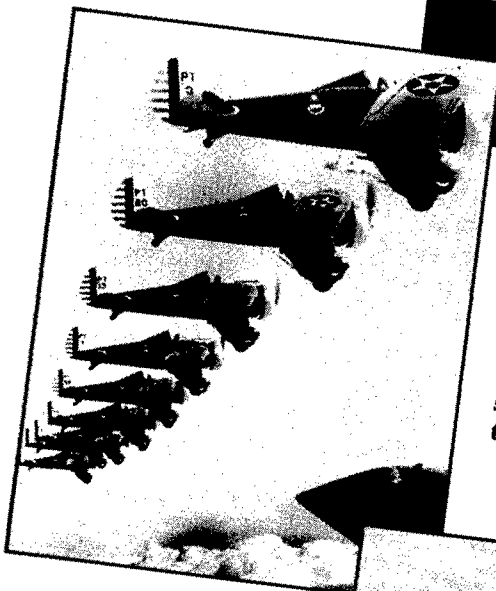
Interwar Air Service Pioneers



Top to bottom: Suited for extreme cold, Lieutenant John Macready with the Packard LePere aircraft in which he set the American altitude record of 34,508 feet in 1921; Sergeant Roy Hooe, Lieutenant Harry Halverson, Captain Ira Eaker, Major Carl Spatz (later spelled Spaatz), and Lieutenant Elwood Quesada after their record-setting endurance flight in the Fokker Trimotor *Question Mark* in 1929; the *Question Mark* being refueled on its famous flight; Lieutenant Jimmy Doolittle in the Consolidated NY-2 he piloted during blind flying tests in 1929. The enclosing hood is folded around the cockpit.



Interwar Aircraft



In amazing technological leaps, interwar military aircraft evolved significantly from, *top to bottom*, biplanes such as the Keystone B-4 bomber and Boeing P-12 fighter, to some of the first all-metal American monoplanes such as the Boeing P-26 fighter and the Martin B-10 bomber.



precision bombing was superior to low-altitude bombing and provided greater survivability, explosive force, and, ironically, accuracy. (Bombs released at low altitudes tumbled and ricocheted when they hit the ground.) He wrote, "Bombardment missions are carried out at high altitudes, to reduce the possibilities of interception by hostile pursuit and the effectiveness of anti-aircraft gun fire and to increase the explosive effect of the bombs." The keys to attaining accuracy from high altitudes were Carl Norden's new M-series bombsights, designed under Navy contract, but destined to equip Air Corps bombers beginning in 1933.

At Maxwell Field in Montgomery, Alabama, Major Donald Wilson and the faculty of the Air Corps Tactical School proposed in the early 1930s to destroy an enemy's ability to resist by bombing what Wilson called the "vital objects of a nation's economic structure that tend to paralyze the nation's ability to wage war and . . . the hostile will to resist." Because of America's opposition to attacking civilians or non-military targets, this bombing would be aimed not directly at an enemy's will, but at the machines and industries that supported that will and its military defenses. The destruction of an enemy's vital industries would destroy its ability to continue to wage war. Wilson viewed high-altitude precision bombing as "an instrument which could cause the collapse of this industrial fabric by depriving the web of certain essential elements—as few as three main systems such as transportation, electrical power, and steel manufacture would suffice."

The technological innovations of the 1930s, which so profoundly inspired the ideas of Walker and Wilson among others, were applied in particular to the large aircraft demanded by America's airlines, and they created a curious situation—large bombers flew faster than small fighters. Thus was born the conviction among airmen, as expressed by Brigadier General Oscar Westover: "No known agency can frustrate the accomplishment of a bombardment mission." The B-17 of 1935 could reach 252 miles per hour at high altitudes, compared with the P-26 front-line fighter, which could not exceed 234. Because speed would allow a bomber to overcome enemy aerial defenses, strategic bombing became the focus of air power development for Mitchell, Walker, Wilson, Wright Field's engineers, and such Air Corps leaders as Brigadier General Henry "Hap" Arnold, commanding the 1st Bombardment Wing, who labored to create the tactical formations, flying techniques, and organization needed for this new kind of warfare.

Upon the recommendation of a War Department committee, known as the Baker Board (named for former Secretary of War, Newton Baker), Congress established the General Headquarters Air Force (GHQ

AF) on March 1, 1935. This first American “named” air force, under the command of Brigadier General Frank Andrews and headquartered at Langley Field in Virginia, controlled all offensive aviation in the nine corps areas of the United States, including organization, training, and operations. Powerful opponents in the Army separated the GHQAF from the Air Corps under Major General Westover, in charge of individual training, procurement, doctrine, and supply. The Air Corps remained a combatant arm of the Army, while the GHQAF came under the Chief of Staff in peacetime and the commander of field forces in wartime. The two air components remained divided until March 1, 1939, when the GHQAF came under the control of the Chief of Air Corps.

The MacArthur-Pratt agreement of 1931 made the Air Corps responsible for short-range coastal defense and Army operations on land, but left the Navy as America’s offensive force on the sea. Two developments changed this division of responsibility. First, advances in aviation technology made restrictions to short-range operations nonsensical, as when three B-17s intercepted the Italian liner *Rex* in the Atlantic over 700 miles from America’s shores in 1937. Still, the Army continued buying, for the most part, short-range tactical aircraft, including the twin-engine B-18, to support ground operations. Second, Adolf Hitler’s successful use of air power as a threat in the Sudetenland-Czechoslovakia crisis of 1938 convinced President Franklin Roosevelt that the United States needed a large air force “with which to impress Germany,” and ordered the acquisition of 10,000 aircraft (later 5,500) when Congress appropriated \$300 million for the buildup.



Brigadier General Frank Andrews with his staff at ceremonies inaugurating his leadership of the new General Headquarters Air Force’s (GHQAF’s) command.

When Germany invaded Poland in September 1939, the Air Corps had 26,000 officers and airmen and a heavy bomber force of only 23 B-17s. Chief of Air Corps Arnold had used President Roosevelt's support and British and French orders for 10,000 additional aircraft to launch a huge expansion of the aviation industry. With the fall of France in June 1940, Roosevelt ordered an Air Corps of 50,000 aircraft and 54 combat groups. Congress appropriated \$2 billion, eventually, to insure funding for both strategic and tactical air forces. In March 1941 the Air Corps expanded to 84 groups. These actions and events presaged what would become the largest air force in the world equipped with the most modern aircraft available. By December 1941, however, the Army's air force still had only 3,304 combat aircraft, but World War II mainstays such as P-51 Mustang and P-47 Thunderbolt fighters and the B-29 Superfortress bomber still were not operational. All would become part of the U.S. Army Air Forces (USAAF) led by Major General Hap Arnold, established under Army Regulation 95-5 on June 20, 1941, with the Air Corps and the Air Force Combat Command (formerly the GHQAF) as subordinate arms. Less than a year later, Army Chief of Staff George Marshall made the USAAF coequal to the Ground Forces and Services of Supply.

In August 1941, at the behest of the War Department, USAAF Chief Arnold directed four former faculty members of the Air Corps Tactical School to devise an air plan against America's potential adversaries. Lieutenant Colonels Kenneth Walker and Harold George and Majors Haywood Hansell and Laurence Kuter of the newly-formed Air War Plans Division (AWPD) identified in their plan 154 "chokepoint" targets in the German industrial fabric, the destruction of which, they held, would render Germany "incapable of continuing to fight a war." A lack of intelligence prevented the design of a similar plan against Japan. The four planners calculated that the desired air campaign would require 98 bomber groups—a force of over 6,800 aircraft. From their recommendation General Arnold determined the number of supporting units, aircraft, pilots, mechanics, and all other skills and equipment the USAAF would need to fight what became World War II. The 239 groups estimated came close to the 243 combat groups representing 80,000 aircraft and 2.4 million personnel that actually formed the USAAF in 1944 at its wartime peak. The planners had also assumed that they would not have to initiate their air plan, known as AWPD/1, with a complete 98-group force until April 1944. However, they were not allowed the luxury of time. When the Japanese attacked Pearl Harbor four months after the air plan's submission to the War Department, an ill-equipped USAAF found itself thrust into the greatest war in human history.

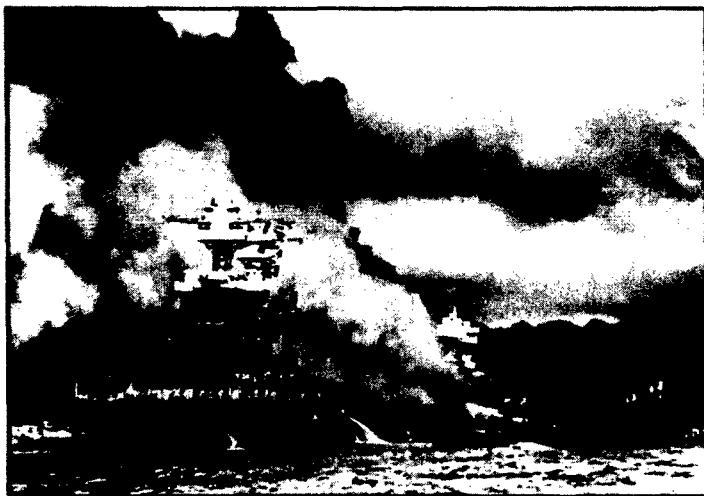
World War II—Global Conflict

Despite the heroics of such airmen as Lieutenant George Welch, who was credited with having downed 4 enemy aircraft, the surprise strike on Pearl Harbor showed the limitations of the USAAF's preparations for war. The Hawaiian Air Force lost 66 percent of its strength on December 7, 1941, while the Japanese lost only 29 pilots. Across the International Dateline, Lieutenant Joseph Moore claimed 2 Japanese aircraft the next day in the skies over Clark Field in the Philippines, but General Douglas MacArthur's air force of 277 aircraft, including 2 squadrons of B-17s (35 aircraft in all), was destroyed. These greatest concentrations of American air power at the time had failed to deter or hinder the Japanese.

At the start of World War I a solid industrial infrastructure on which to construct the world's greatest air force had not existed in the United States. At the start of World War II this was not the case. The aircraft manufacturing sector was large and growing daily. Before the war, General Arnold had established nine civilian primary flight training schools, two Air Corps basic flight training schools, and two Air Corps advanced flight training schools. The number of trained pilots had jumped from 300 in 1938 to 30,000 in 1941 (plus 110,000 mechanics). On December 7, 1941, the USAAF had a running start and was in the war for the duration.

Arnold planned first for vastly expanded production, training, and research, with the long-term military interests of the nation in mind. While German factories maintained a one-shift peacetime work week until 1943, American plants ran around the clock. Swelled by hundreds of thousands of women, more than two million American workers built nearly 160,000 aircraft of all kinds for the Army and 140,000 for the Navy and Allied nations during the war. America's aircraft production overwhelmed that of every other nation in the world. Altogether, its factories turned out 324,750 aircraft for the war effort; Germany's factories turned out 111,077 and Japan's 79,123. Where other nations stopped production lines to make modifications, or manufactured models long obsolescent, the United States, according to Arnold's orders, left its factories alone to insure high production levels and established separate depots to modify and modernize older models. Until the German Me 262 jet, American aircraft set the standard for performance and combat success with their ruggedness (the B-17 Flying Fortress, B-24 Liberator, and P-47 Thunderbolt); their range and bomb load (the B-29 Superfortress); their range, speed, and agility (the P-51 Mustang); and their utility (the C-47 Skytrain). Eventually, they were to equip 243 groups, consuming about

Devastation and Renewal



Pearl Harbor, December 7, 1941. Japan's surprise attack against American naval and air forces, *above*, at installations on the Hawaiian island of Oahu, precipitated the entry of a shocked United States into World War II. It also set into motion an unprecedented arms buildup as America's factories, *below*, churned out weapons of war such as these Consolidated Vultee Aircraft Corporation B-24 Liberator bombers on an around-the-clock basis.



35 percent of America's total investment in equipment and munitions for the war. They were supported and flown by two and a half million men and women, nearly a third of the U.S. Army's total strength.

As important as production to Arnold was training. The demands of flight required the best from the brightest. Voluntary enlistments swelled the USAAF initially, supplemented by a pool of deferred flyers previously enrolled in the Air Corps Enlisted Reserve. Flying Training Command prepared nearly 200,000 pilots, nearly 100,000 navigators and bombardiers, and many hundreds of thousands of gunners and other specialists. American pilots received more uninterrupted training than those of any other nation, again because of Arnold's strategic vision and America's bountiful resources. Primary, basic, and advanced training were for individual flyers, brought together at operational training units under the First, Second, Third, and Fourth Air Forces and I Troop Carrier Command for forming into new units. Technical Training Command prepared over two million others, mostly mechanics and specialists to keep aircraft airworthy. Arnold and others labored to insure that the equipment these legions employed was the most advanced available. Research centers and test facilities sprang up all over the United States, dedicated to stretching aviation performance to the limit—and beyond. High octane aviation gasolines, radars, jets, rockets, radios, and special bombs were all products of the USAAF's commitment to basic and applied research and development.

This enormous aerial force was wielded by General Arnold, who assumed control over all USAAF units, with the War Department reorganization of March 1942. He quickly agreed with General George Marshall to postpone any discussion of an independent air force until after the war. However, Arnold was a member of both the American Joint Chiefs of Staff (JCS) and the joint American and British Combined Chiefs of Staff. The March 1942 reorganization and Arnold's position on the Combined Chiefs of Staff, nevertheless, gave the USAAF a large measure of autonomy, which was subsequently enhanced with the formation of the Twentieth Air Force (responsible for the B-29 campaign against Japan and under Arnold's direct command). A tireless commander, Arnold sacrificed his health building a winning air force.

Before the United States entered the war, American and British officials met from January to March 1941 for the ABC-1 talks and agreed on a strategy for defeating the Axis nations. They decided that because Germany represented the stronger enemy, British forces in the Mediterranean would hold their positions. In the Pacific, American forces would go on the strategic defensive, while Allied armies in Europe built up for

an eventual landing on the continent followed by a victorious march to Berlin. After December 1941, however, events worked to modify this strategy. First, the U.S. Navy successfully bid for higher priority in the Pacific in an early two-pronged assault on Japan, one from Australia and New Guinea through the Philippines, the other through the islands of the South and Central Pacific. Second, in Europe, British demands for action in the Mediterranean and the immediate need for a reduction of German pressure on the Soviet Union diverted British and American forces to fight in North Africa. These developments left only the England-based Allied air forces to attack the German homeland through a strategic bombing campaign.

On June 12, 1942, the USAAF inaugurated operations in the Mediterranean, striking against the Ploesti, Romania, oil fields, a target American airmen would come to know well. Large-scale action began with Operation TORCH—the invasion of North Africa—six months later on November 8. American doctrinal and organizational problems allowed the German *Luftwaffe* to achieve early domination in the air. Allied ground commanders demanded that air units maintain continuous air cover over Army formations. Their firepower thus diluted, “penny packets” patrolled the skies constantly, rarely finding the enemy, and were therefore not available in sufficient numbers when the *Luftwaffe* made concentrated attacks. German pilots achieved a three-to-one advantage in aerial victories. At the Casablanca Conference, in late January 1943, the United States adopted a tactical doctrine formulated by British commanders Arthur Coningham and Bernard Montgomery after bloody fighting against Germany’s Afrika Korps. Air superiority became their first objective for the air arm, including deep sweeps against enemy airfields, followed by interdiction to isolate battlefields, and then close air support to assist ground units in their movements against the enemy. Air and ground commanders would work together, neither auxiliary to the other.

Codified as Field Manual 31-35, this new doctrine of tactical warfare served the USAAF well. With their air forces organized into an independent Northwestern African Air Forces under General Carl Spaatz, including a Strategic Air Force under General Jimmy Doolittle and a Tactical Air Force under Coningham, the Allies achieved air superiority in the spring of 1943 and cut the flow of supplies and reinforcements to Field Marshal Erwin Rommel’s army in North Africa. Allied commanders had the assistance of ULTRA intercepts, the top secret code-breaking operation, that provided detailed information about German ship and aircraft schedules. Axis armies in Tunisia, numbering 270,000 men, surrendered in May.



Principal American participants at the Casablanca Conference in French Morocco. Planning meetings on Allied war strategy between President Roosevelt, Prime Minister Churchill, and the Combined Chiefs of Staff in January 1943 included Lieutenant General Henry Arnold, Commanding General, USAAF. *Seated, left to right, General George Marshall, President Roosevelt, and Admiral Ernest King. Standing, left to right, Harry Hopkins, General Arnold, General Brehon Somervell, and Averell Harriman.*

These initial steps toward organizing air power as an independent, unified force also led Army Chief of Staff George Marshall to issue Field Manual 100-20 in 1943. This document, the USAAF's "declaration of independence," recognized "land power and air power" to be "coequal and interdependent forces." In the Mediterranean, the Twelfth Air Force neutralized the *Luftwaffe* when Allied forces invaded Sicily in July and the Italian peninsula in September. Tough fighting slowed Lieutenant General Mark Clark's forces as they pushed northward, forcing him to rely increasingly on USAAF assistance to break through German lines. Since the bombing of the abbey at Monte Cassino failed to break the stalemate on the ground, USAAF units focused their attention on interdiction. Operation STRANGLE hoped to cut the flow of supplies to German defenders in Italy. The Twelfth Air Force learned how difficult that could be. Downing bridges, strafing trains and trucks, and bombing supply dumps contributed to eventual victory in 1945, but the protection of darkness gave the enemy opportunities to supply its forces.

AWPD/1 had called for a strategic bombing campaign against the sources of Germany's power as the most efficient and effective means of achieving victory. With the United States on the defensive in the Pacific and Allied units bogged down in North Africa, the Eighth Air Force in England joined the Royal Air Force (RAF) in the largest strategic bombing campaign ever attempted. Progress was slow through 1943. Airfields had to be built, crews trained, aircraft modified. Circumstances diverted Eighth Air Force units to pressing needs elsewhere in the world. The first official bombing mission did not come until August 17, 1942, when twelve B-17s of the 97th Bomb Group, accompanied by Eighth Air Force commander Ira Eaker, attacked a marshalling yard in France. The Eighth Air Force, along with the RAF and the Italy-based Fifteenth Air Force (beginning in late 1943), would be the only Allied forces attacking targets inside Germany's borders until late 1944.

Missions through the summer of 1943 were trial and error, as the Eighth Air Force slowly pushed deeper into German-occupied territory. Prewar doctrine dictated that unescorted self-defending bombers could fight their way through air defenses to destroy targets in an enemy's heartland. Attacking in small numbers (AWPD/1 had called for a force of 6,834 bombers), the USAAF was severely tested by poor weather, bombing inaccuracy, diversions of bombers to North Africa and against submarine pens, and stiff enemy defenses as it attempted to get at Germany's industrial web.

While the Eighth Air Force labored to overcome these challenges, the Air Staff, the AWPDP, and the Committee of Operations Analysts worked to identify for destruction chokepoints in the German war economy. Although RAF Bomber Command's Arthur Harris wanted the USAAF to join him in a night campaign of area bombing to destroy Germany's cities, the Combined Chiefs of Staff at the Casablanca Conference gave its support for daylight precision strategic bombing. AWPDP/1 had identified 154 targets. A new plan, AWPDP/42 found 177. In late April 1943 at the Trident Conference, the Combined Chiefs approved a list of 76 targets as Eighth Air Force objectives. The Eighth Air Force, with the RAF, was to win air superiority, an "intermediate objective second to none in priority," and weaken Germany enough to allow an invasion. Its undertaking was to be known as Operation POINTBLANK, the Combined Bomber Offensive.

The pace of operations intensified for the 17 groups General Eaker had available in July 1943. Brigadier General Laurence Kuter and Colonel Curtis LeMay worked out combat formations at the wing and group levels to maximize the number of defensive machine guns to be

brought to bear against attacking fighters. Day after day, weather permitting, the Eighth Air Force struck at German airfields, aircraft depots, and aircraft industry, hoping to win air superiority by bombing the *Luftwaffe* on the ground; in late July alone it lost 10 percent of its attacking bombers. In August it struck at ball bearing factories in Schweinfurt and the Messerschmitt aircraft factory at Regensburg while the Twelfth Air Force hit oil refineries in Ploesti, Romania, and aircraft factories in Wiener Neustadt. Eighth Air Force P-47 Thunderbolt fighters were soon outfitted with drop tanks, which extended their range and were intended to reduce losses as they escorted the bombers, but the *Luftwaffe* simply withheld attacking until they ran short of fuel and had to return to England.

The second week of October 1943 marked the high point in the Eighth Air Force's initial campaign. Scoring some bombing successes, General Eaker's command lost 8 percent of its bombers over Bremen, 8 percent over Anklam-Marienburg, 13 percent over Münster, and 26 percent in a return trip to Schweinfurt. The loss of over 1,000 crewmen and nearly 150 bombers forced a change in American strategy. First, Arnold ordered all long-range P-38 Lightning and P-51 Mustang groups completing training in the United States to England to provide escort for the bombers for the duration of the war. Second, he created a new strategic air force in Italy, the Fifteenth, to attack Germany from the south. Third, he revised the command structure of the strategic bombing effort, moving General Spaatz to England as head of United States Strategic Air Forces in Europe (USSTAF) to command the bombing campaign against Germany, assisted by Fred Anderson and Jimmy Doolittle as operational commanders and William Kepner as fighter commander. Eaker went to command the Mediterranean Allied Air Forces, including the Fifteenth and Twelfth Air Forces.

Change came quickly. Kepner revised fighter tactics to include phased and relay escort to extend the range of the fighters accompanying the bombers deep into Germany, especially when P-51 groups began arriving in December 1943. Doolittle ordered Kepner to unleash his fighters, assigned not just to escort bombers, but to go out, find, and destroy *Luftwaffe* aircraft. Kepner told his pilots to strafe German fighters on the ground if necessary. On February 20, 1944, Spaatz and Anderson began an all-out bombing offensive against German aircraft production. Five days of bombing, nineteen thousand tons worth, impaired some production; but the key to Big Week's effectiveness was the *Luftwaffe's* loss of one-third of its strength through aerial combat, and the Eighth and Fifteenth Air Forces growth in theirs.

To keep up the pressure, Spaatz and Anderson resolved to bomb industrial targets in Berlin, under the assumption that the *Luftwaffe* would make an all-out effort to defend its capital. Their assumption was correct. Two days of the heaviest fighting yet seen in the skies over Germany so depleted the defender's forces that on the third day, March 9, 1944, the *Luftwaffe* failed to rise and give battle. Anderson relished reports that Berlin radio was "squealing like a stuck pig." The *Luftwaffe* grew weaker and the USAAF grew stronger as new groups, both fighter and bomber, arrived from the United States. A flood of men and materiel bespoke Arnold's 1941 commitment to prepare for a long war. Further attrition of the German defenders would be necessary in future months, but air superiority was now firmly in American hands.

To Arnold and Spaatz, this hard-won victory finally opened German industries to destruction from the air. Two conditions affected the strategic bombing effort and delayed the final bombing campaign. The pending V-weapon assault by Germany on England forced a massive preemptive Allied bombing campaign against it, diverting 6,100 sorties from POINTBLANK strategic targets. The cross-channel invasion,



American air leaders in Europe. *Center*, Carl Spaatz, Commanding General, United States Strategic Air Forces (USSTAF), in the top command position over America's air chiefs; *left*, Ira Eaker, Commanding General, Mediterranean Allied Air Forces (MAAF); *right*, Frederick Anderson, Deputy for Operations, USSTAF; and, *below*, William Kepner, Commanding General, Eighth Fighter Command, and Jimmy Doolittle, Commanding General, Eighth Air Force.



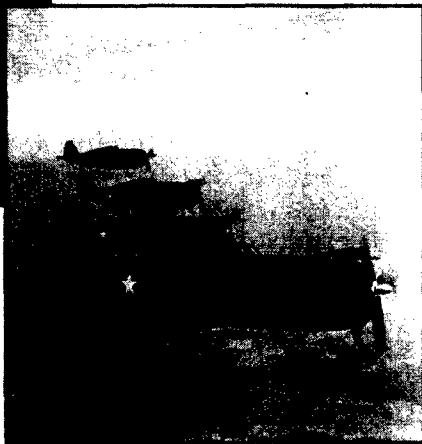
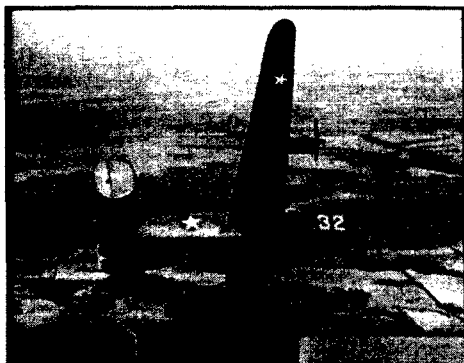
scheduled by the Allies for late spring, diverted Eighth Air Force bombers against transportation targets in France to isolate the invasion area. In support of the invasion, Spaatz wanted to go after German oil targets to ground the *Luftwaffe* and force the German army to park its vehicles. Invasion commander General Dwight Eisenhower overruled him on March 25, assigning USSTAF to interdict the landing area. VIII Fighter Command under Kepner continued to strafe German airfields and other ground targets through June.

When eight Allied divisions landed in Normandy on June 6, 1944, they did so under conditions of near total Allied control of the air, courtesy of USSTAF—only two *Luftwaffe* fighters appeared in the area that day. In late July USSTAF bombers again proved critical to the ground campaign as they blasted a hole through German lines at St. Lô for Lieutenant General George Patton's Third Army. Allied tactical air forces, which included Major General Elwood Quesada's IX Tactical Air Command for the First Army and Major General Otto Weyland's XIX Tactical Air Command for the Third Army, provided protective cover and close air support, in line with procedures established in North Africa, for Allied armies sweeping across France toward Germany. At Argentan-Falaise in August air power plugged the gap between encircling American and Canadian armies, destroying hundreds of German armored vehicles and aiding in the capture of fifty thousand German troops. During the Battle of the Bulge in December, airlift, aerial interdiction, and close air support helped turn a near-disaster into an Allied victory.

Eighth and Fifteenth Air Force attacks on Germany's fuel industry provided immeasurable help to the ground offensives, restricting severely the ability of German ground forces to maneuver their armored and mechanized units. Allied air superiority, a product of the Eighth Air Force's aerial campaign, had permitted the landings in Europe, the Allied armies freedom of maneuver, and resupply without concern for the *Luftwaffe*. Germany had shown the world in 1939 and 1940 what close coordination between tactical air power and ground armies could accomplish. The USAAF repaid the favor with a vengeance in the drive from Normandy into Germany in 1944 and early 1945.

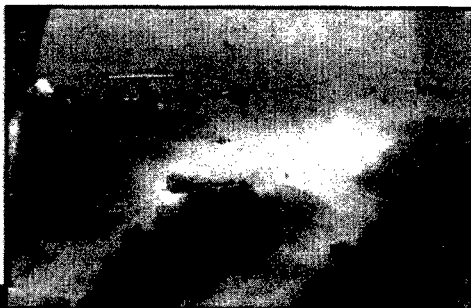
Eisenhower held first call on Spaatz's strategic bombing force through the summer of 1944, but allowed it to return to POINTBLANK objectives with an assault on Germany's oil production when it was not bombing targets in France in support of ground units. ULTRA intercepts confirmed that the USAAF had finally found a true chokepoint in the German industrial economy. German armaments minister Albert Speer predicted that continued attacks on it would have "tragic consequences."

America's Air War in Europe



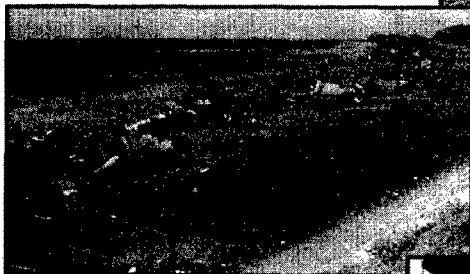
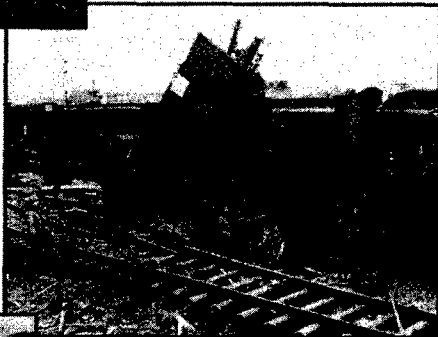
The formidable aerial armada unleashed by the USAAF's victorious Eighth, Ninth, Twelfth, and Fifteenth Air Forces against enemy targets in Europe during World War II included, *top to bottom*, Consolidated B-24 Liberator and Boeing B-17 Flying Fortress bombers, and, performing fighter, escort, and close air support duties, North American P-51 Mustangs and Republic P-47 Thunderbolts.

Right, a Fifteenth Air Force high-altitude B-24 bombing raid against the extensive Rumanian oil refinery complex at Ploesti. Bursts of deadly flak from anti-aircraft emplacements explode around the USAAF airmen as they approach their targets.



Left, A Ninth Air Force B-26 Marauder after bombing German troop concentrations for Operation OVERLORD, the Allied invasion of Normandy on D-Day, June 6, 1944. Air power was essential to the undertaking's success.

Right, the aftermath of an Eighth Air Force attack. Bomb craters, severed rails, and battered boxcars in a German marshalling yard attest to the level of damage caused by airmen who suffered bad weather, Luftwaffe fighters, anti-aircraft fire, and dense cloud cover to halt the movement of enemy troops and equipment.



Left, Italian Macchi and Fiat aircraft wrecked and scattered across an Axis airfield on Pantelleria after a Twelfth Air Force bombing campaign wrested control of the strategically sited Mediterranean island.

Right, ruin at Ploesti. The Fifteenth Air Force bombed oil refineries in Romania in over 20 low- and high-level, large-scale, punishing raids. The USAAF airmen encountered heavy defenses and suffered grave losses.



Despite heroic efforts to restore production, Germany found its tanks and aircraft immobilized because of growing fuel shortages. The entrance of the Me 262 jet fighter into combat inflicted occasional heavy losses on USSTAF, including thirty-three of the 445th Bombardment Group's thirty-seven bombers on September 27, 1944, but it could not change the war's outcome.

Adding Germany's railroad network to its priority target list in the autumn of 1944, USSTAF brought Germany's economy to the point of collapse by February 1945. Responding to temporary German successes during the Battle of the Bulge, Soviet requests, and a desire to hasten the enemy's surrender, USSTAF joined with the RAF in area-bombing Berlin, Dresden, and other German cities in February. Assigned targets remained industrial and transportation chokepoints in keeping with precision strategic bombing doctrine, but clouds and other factors made these missions, in effect, terror bombings. Spaatz declared an end to the strategic bombing campaign on April 16, 1945.

American airmen had decided that they could defeat the enemy most efficiently by destroying its industrial web through precision strategic bombing. In so doing they hoped to prevent a repeat of World War I's trench warfare. Ironically, the contest they found in the skies over Europe from 1942 to 1945 was in many ways just as bloody as the earlier war's contest on the ground. Medal of Honor recipient Lieutenant William Lawley of the 305th Bombardment Group flew a B-17 back from Heiterblick, over 550 miles, with a face full of broken glass and shrapnel, a dead copilot draped over the controls, wounded crewmen, and only one engine running. The numbers associated with the USAAF's tactical and strategic campaigns against Germany reveal the ferocity of the air war: 1.6 million tons of bombs dropped on Europe, 765,000 bomber sorties, 929,000 fighter sorties, 31,914 airmen dead (by combat and accident), and 27,694 aircraft lost (by combat and accident).

In the waning days of the war against Germany, Arnold ordered an independent team to evaluate air power's accomplishments and failures. Their product, called the *United States Strategic Bombing Survey* (USSBS) and supported by 216 volumes of analysis and documentation on the European war (another 109 covered the war against Japan), concluded "that even a first-class military power—rugged and resilient as Germany was—cannot live long under full-scale and free exploitation of air weapons over the heart of its territory." The USSBS admitted that a slow buildup of aerial forces and inaccurate bombing had kept air power from reaching its potential, but judged as "decisive" the diversion of Germany's capabilities from the supporting of armies to the defending of

its own skies, the attrition of enemy air forces, and the destruction of enemy oil supplies and transportation networks. The strategic bombing campaign forced Germany to divert 40 percent of its industry to aerial defense, 2 million of its workers to manufacturing supplies and equipment for air defense, 2 million of its soldiers to manning ground defenses, and 2.5 million of its laborers to cleaning up the damage. Victory in the air was "complete," and air power had helped "turn the tide overwhelmingly in favor of Allied ground forces."

Despite Europe's priority in Allied planning, America's first strategic bombing effort of the war began against Japan, when sixteen B-25 Mitchell bombers under the command of Lieutenant Colonel Jimmy Doolittle and launched from the USS *Hornet* attacked targets on the Japanese home island of Honshu in mid-April 1942. Although militarily insignificant, the Doolittle raid embarrassed and infuriated Japanese military leaders and raised Allied morale. It was an omen of what Japan could expect from America's air power.

All the while, the Pacific war was more than just half-a-world away. In Europe the United States had powerful allies to consult and support at every turn. Except for the British Empire's forces in India, Burma, and Australia, the war against Japan was an American show. Europe had Eisenhower to unite British and American armies, navies, and air forces. In the Pacific, the U.S. Army and U.S. Navy competed in the drive toward the Japanese homeland. In General Douglas MacArthur's Southwest Pacific Area, the U.S. Army fought from Australia through New Guinea to Leyte and Luzon in the Philippines. In Admiral Chester Nimitz's Pacific Ocean Areas, the U.S. Navy moved among the islands from the Solomons and Gilberts through the Marshalls, Carolines, and Marianas to Iwo Jima and Okinawa. Combined with a lesser American effort to support China's war against Japan, the distances involved insured a major role for the USAAF.

In the Army's initial fighting on Papua New Guinea, thick jungles, rugged terrain, and inadequate forces restricted the help the USAAF could provide for MacArthur's hard-pressed command. By December 1942 the Fifth Air Force under Major General George Kenney had sufficient numbers of P-38s to seize air superiority over the island, allowing its B-17, B-24, B-25, and A-20 bombers to cut the flow of Japanese reinforcements and supplies. Kenney proved the master tactical innovator, developing skip bombing to sink enemy ships and arming his medium bombers with extra nose-mounted machine guns and even 75-mm cannon to improve their firepower. Kenney took a "seamless" approach to air power that had, in Carl Spaatz's words, "no line of cleavage

Holding the Line in the Pacific



Top, Lieutenant Colonel Jimmy Doolittle and his Tokyo Raiders on board the USS *Hornet*, from whose deck they flew a formation of North American B-25 Mitchell bombers to attack the home of the Japanese empire and raise the spirits of discouraged Americans in 1942. Captain Marc Mitscher, the *Hornet's* skipper, stands at Doolittle's left; *center, left*, Major General Claire Chennault, leader of the legendary Flying Tigers and, *bottom, left*, Major General George Kenney, Commanding General, Fifth Air Force, fought the conquest-hungry Japanese valiantly while Allied resources were directed to "Europe first"; *center, right*, the Douglas C-47 Skytrain transport, an indispensable workhorse in Asia. C-47 "Hump" flights from the U.S. Tenth Air Force's hastily-built base in Assam, India, over the Himalayas relieved the beleaguered Allies fighting in China after the Japanese cut off their overland supply route; *bottom, right*, Brigadier Generals Heywood Hansell and Curtis LeMay, first and second leaders of XXI Bomber Command of the Twentieth Air Force. LeMay employed the command's B-29s, prone to engine fires and imprecise targeting at high altitudes, as successful medium-altitude bombers in incendiary raids over much of Japan.

between strategic and tactical air forces." One day his heavy bombers would attack enemy troop formations hundreds of feet from American lines; the next, they pursued enemy shipping hundreds of miles behind enemy lines.

General MacArthur adopted an island-hopping strategy, skipping over large enemy forces in the American drive northward, and, because of the Fifth Air Force's command of the air, leaving isolated Japanese garrisons to starve, cut off from resupply and rescue. The range of General Kenney's aircraft determined the distance to the next objective. By October 1944 MacArthur's army was ready to leap from New Guinea to Leyte in the Philippines, a target beyond the range of land-based air power. Admiral William Halsey's carriers provided air cover until Kenney's Far East Air Forces (FEAF), which combined the Fifth and Thirteenth Air Forces, could move to the Philippines. There, FEAF became engaged in the Army's longest Pacific land campaign, which continued until the end of the war.

The USAAF also became involved in the frustrating and costly effort to keep Chiang Kai-shek's China in the war, tying down dozens of Japanese divisions. Initially this involved Claire Chennault's small mercenary force of private American pilots in China's pay, the Flying Tigers, who captured headlines in the United States when victories of any kind were few in number. With their occupation of Siam and Burma by mid-1942 the Japanese had isolated China, blockading it by sea and cutting supply roads. The USAAF had little choice but to launch a resupply effort into China over the "Hump"—the Himalaya Mountains—from India. The route took American crews above some of the most dangerous terrain in the world in overloaded C-46 and C-47 transports not designed for the weather and high altitudes the missions required. By war's end Hump pilots had ferried 1.18 million tons of supplies from India into China for the fight against Japan.

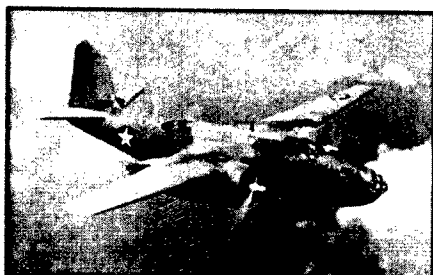
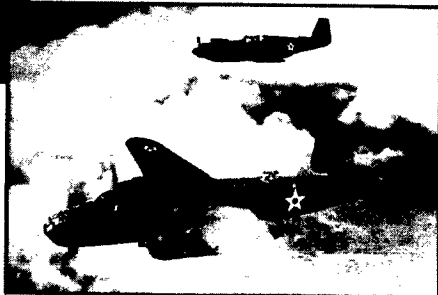
Although America's original Pacific strategy sought to choke the enemy through a naval blockade, after three years of war Japan remained unwilling to surrender. For Hap Arnold, a strategic bombing campaign employing B-29s would force it to capitulate, obviate the need for an Allied land invasion, and present an opportunity to prove the war-winning potential of an independent air force. The JCS had approved Arnold, as their executive agent, to command the Superfortresses of the Twentieth Air Force. They could strike from fifteen hundred miles, but even their great range left few options for bases from which to launch the air assault. Nimitz's drive through the Marianas in the summer of 1944 freed Tinian, Guam, and Saipan to base the B-29s of Brigadier General Haywood

America's Air War in Asia



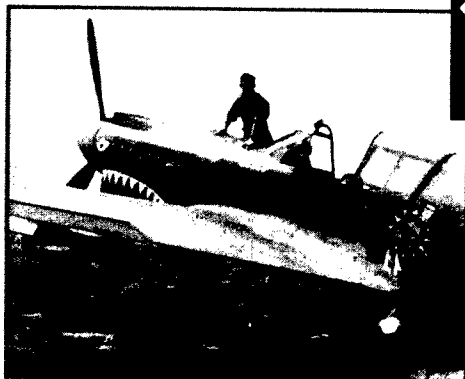
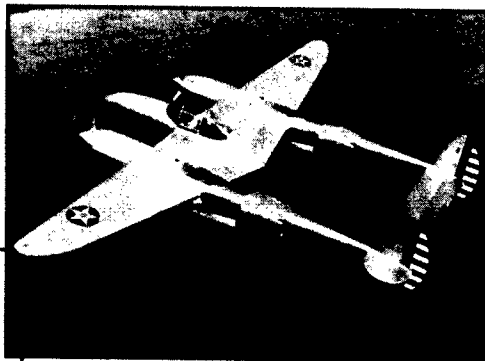
Left, the mainstay of Allied victory in Asia, the rapidly-developed Boeing B-29 Superfortress bomber, not deployed in Europe, but saved to surprise the Japanese. It had both the longer range and the capacity to carry the atomic bomb to the heart of Japan itself from bases on formerly enemy-held southern Pacific islands.

Right, the North American B-25 Mitchell bomber, strengthened with more firepower by General Kenney's great innovator, Major Paul "Pappy" Gunn, and used as a highly effective ship buster and skip bomber.

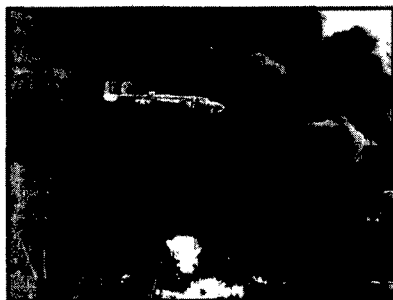


Left, the sturdy Douglas A-20 Havoc. More A-20s were procured by the USAAF than any other attack-type aircraft. They saw service in Europe and North Africa but played a vital role in the Pacific dropping "parafrags" (fragmentation bombs attached to parachutes) from low altitude.

Right, the distinctively silhouetted, long-range, twin-engine Lockheed P-38 Lightning fighter. In mass production before the United States entered the war, it served escort duty in Europe, North Africa, and, as early as 1942, in the Southwest Pacific.



Left, the Curtiss P-40 Warhawk fighter, associated with the exploits of the American Volunteer Group's (AVG's) famous Flying Tigers. The AVG began operating from bases in western China against the Japanese before the United States entered the war. The aircraft's decorative shark's teeth are recognized the world over.



Hard-won victory. *Top to bottom:* USAAF airmen of the Fifth, Seventh, Thirteenth, and Twentieth Air Forces helped American soldiers and seamen achieve a stunning Allied triumph in World War II's Asian theaters. Facing the vastness of the Pacific, they fought grueling and costly island-hopping battles to gain forward bases from which they could launch aerial attacks against a seemingly implacable enemy, and time and again they sought out jungle-shrouded coastal and mountain strongholds, airfields, and well-armed, heavily escorted ship convoys. Atomic bombs over Nagasaki and Hiroshima finally ended the war and saved the lives of thousands of Americans who would have perished invading the Japanese home islands.

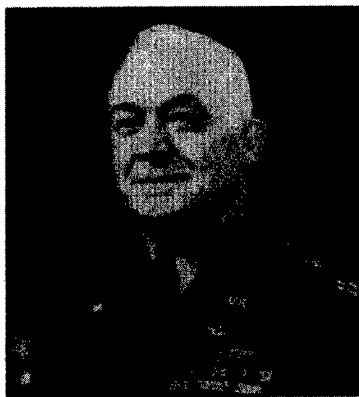
Hansell's XXI Bomber Command, the combat arm of the Washington-based Twentieth Air Force. Iwo Jima, conquered after heavy fighting in February 1945, provided an emergency landing field for damaged B-29s and a base for P-51 fighter escorts. After a largely futile strategic bombing effort from India and China in 1944, XX Bomber Command joined Hansell's growing force in the Marianas early in 1945 for the final strikes against Japan.

Hansell, an author of AWPD/1, stayed true to high-altitude daylight precision strategic bombing doctrine, beginning with XXI Bomber Command's first mission against the Japanese home islands on November 24, 1944. His assignment was to "achieve the earliest possible progressive dislocation of the Japanese military, industrial, and economic systems and to undermine the morale of the Japanese people to a point where their capacity and will to wage war was decisively weakened." He faced technical problems (including B-29 engines that tended to burst into flames), unanticipated 200 mile-per-hour winds of the jet stream over the home islands, and bad weather when striking mainly at Japan's aviation industries. At high altitude bombing accuracy was minimal; only 10 percent of bombs dropped fell within 1,000 feet of a target. Twenty-two missions disabled only one factory.

Arnold replaced Hansell with Major General Curtis LeMay in January 1945, with orders to achieve immediate results. During January and February 1945, LeMay's results were no better than Hansell's. He then surmised that Japanese industry was too dispersed and bombing accuracy too poor for a precision campaign from high altitude in daylight. Recognizing that Japanese air defenses were far weaker than those he had encountered in Germany, but still taking a great gamble to produce immediate results, he ordered his crews to remove their defensive guns and fly low (at seven thousand feet) by night to carry heavier bomb loads, and burn down Japan's cities with incendiaries. The initial raid against Tokyo on March 10, 1945, burned 15.8 square miles of urban area, killed almost 85,000, wounded almost 45,000, made almost 1 million homeless, and became the most deadly air attack in history. By August LeMay's air force had burned 150 square miles in 68 Japanese cities—few of significant size remained undamaged. Faced with an implacable enemy unwilling to surrender and the prospect of a costly invasion, but equipped with a new weapon of tremendous destructive capability, President Harry Truman ordered the first atomic bomb dropped on Hiroshima on August 6 and a second on Nagasaki three days later. Japan surrendered on August 14 after strategic bombing had levelled all of its major cities and killed or injured 800,000 of its people.

Given the great flying distances over open sea, the Pacific war cost the United States over 13,000 aircraft. Most were lost in transit, to battle damage, and through general wear-out. At war's end, the USAAF claimed 9,100 Japanese aircraft destroyed in combat. America's top ranking ace of all time, Medal of Honor recipient Major Richard Bong, became one of the war's last statistics when he crashed in California, test-flying a jet. The Allies used 502,781 tons of bombs against Japan, 160,800 of which were dropped on the home islands. The the B-29 mining campaign and the naval blockade had destroyed Japan's economy, but only a strategic bombing campaign convinced its leaders to surrender.

From 1939 to 1945 the USAAF's personnel strength grew from 24,000 to 2,253,000; its aircraft inventory from 2,400 to 63,715. It dropped 2.05 million tons of bombs in World War II, flying and fighting over every ocean and six continents. Strategic bombing and air power did not live up to doctrinal expectations and win the war independently, but the USAAF forced enemy nations to divert enormous resources and effort toward defending their skies against it. If the USAAF did not make the Army and Navy obsolete, it insured that they rarely had to face the full force of enemy counterparts. Generals learned that air superiority and close air support were essential to the success of any ground campaign and that battlefield air interdiction was perhaps the most difficult of air power functions. North African operations proved that air power worked best when its forces were concentrated and directed as an independent or at least autonomous arm to achieve wartime objectives—coequal to the ground forces, auxiliary to neither. Finally, and to Arnold perhaps most important, the USAAF learned that air power meant planning, organization, training, and harnessing technology and science to produce new ord-



Commanding General, U.S. Army Air Forces, Henry "Hap" Arnold. Under his leadership and fresh from victory in World War II, the USAAF was well-positioned for separation from and equality with the Army as a fully independent service.

nance, radar, jets, rockets, and a variety of advanced aircraft that ensured success in combat.

Air Power in the Nuclear Age

After the war the U.S. Army Air Forces established a number of major commands—Strategic Air Command (SAC), Air Defense Command (ADC), Tactical Air Command (TAC), Air Materiel Command (AMC), and Air Transport Command (ATC, which later became Military Air Transport Service [MATS] and then Military Airlift Command [MAC]), among others. Before his retirement, Hap Arnold, working to insure that America's air force remained at the forefront of science and technology, established a civilian Scientific Advisory Group (now the Scientific Advisory Board), the RAND Corporation "think tank," and several flight testing and engineering centers. Arnold proclaimed "the first essential" of air power to be "preeminence in research." He and General Spaatz proclaimed the second to be education, establishing Air University as a major command.

If the USAAF remained subordinate to the Army, its wartime record and the atomic bomb guaranteed that its status would change. The atomic bomb had altered the nature of warfare. The organization that delivered it, the Twentieth Air Force, was the predecessor of SAC, soon to become the world's dominant military force and responsible for conducting long-range combat and reconnaissance operations anywhere in the world. The *USSBS* had concluded from World War II that "the best way to win a war is to prevent it from occurring." A Strategic Air Command, properly equipped and trained, also would help deter any adversary state from starting a global nuclear war and would thereby ensure international peace.

At war's end the USAAF continued its quest for an American military establishment composed of three coequal and separate military departments. The Navy Department opposed unification and the formation of a separate air force, but the War Department, led by General of the Army Dwight Eisenhower, supported the drive for a separate air component. The National Security Act of July 26, 1947, was a compromise, creating a National Military Establishment under a civilian Secretary of National Defense, with three coequal services that preserved the air arms for the Navy and Marines. President Truman's first choice for Secretary of National Defense, Robert Patterson, turned down the job and James Forrestal, then serving as Secretary of the Navy, was appointed. The U.S.

Air Force (USAF) gained its independence on September 18, 1947, under the Department of the Air Force, headed by Secretary of the Air Force Stuart Symington. General Carl Spaatz was named the first Air Force Chief of Staff.

At a time of demobilization, the National Security Act only postponed a confrontation between the Navy and Air Force over roles and missions in an era of declining defense dollars. For over a century, the Navy had been America's first line of defense and its offensive arm overseas until the era of the long-range bomber and the atomic bomb. Air power appealed to an American love of technology, a desire to avoid heavy casualties, and to austerity-minded presidents like Harry Truman and especially Dwight Eisenhower. The atomic bomb made air power the preeminent force in the postwar world. Giant six- and later ten-engine B-36 Peacemakers seemed to eclipse the Navy's expensive and vulnerable aircraft carriers in the nuclear world. A group of naval officers, led by Admirals Louis Denfeld, Chief of Naval Operations, and Arthur Radford, protested when budget restraints forced a Navy cutback from eight to four carriers and the cancellation of a planned supercarrier, the USS *United States*, large enough to launch atom bomb-carrying aircraft. The outbreak of war in Korea in June 1950 ensured higher defense budgets and limited further interservice contention.

Among the changes wrought by World War II for the U.S. Air Force was that affecting its basic composition. What had been a predominantly white male force became over time more representative of American diversity. African Americans had served in many roles during World War II, most visibly as fighter pilots in the 332d Fighter Group in Italy. Their combat record helped pave the way for the full racial integration of the armed forces under President Truman's July 1948 Executive Order 9981 which stated: "There shall be equality of treatment and opportunity for all persons in the Armed Services without regard to race." The Air Force achieved racial integration quickly and smoothly, eliminating its last segregated unit (the 332d Wing) in June 1949. American airmen first fought together without racial separation during the Korean War—Captain Daniel "Chappie" James, Jr., an African-American recognized and decorated for his performance as a reconnaissance pilot, came out of that experience. Equal opportunities and promotions for African Americans came more slowly, however, causing several riots at Air Force installations in the 1970s; but the service's commitment to a strong equal opportunity program erased remaining racial barriers. The armed services in general were ahead of the rest of American society on this issue.



The newly independent U.S. Air Force's (USAF's) first Secretary, Stuart Symington, and its first Chief of Staff, General Carl Spaatz.

Similarly, the Air Force helped lead the nation in the struggle to extend equal opportunities to women; 29,323 women served in the Army Air Forces in World War II as part of the Women's Army Corps (established on July 1, 1943); another 1,074 served as civilian Women's Airforce Service Pilots (WASPs). Under the leadership of Nancy Love and Jacqueline Cochran, WASPs ferried aircraft and trained male airmen. President Truman signed the Women's Armed Services Act on June 12, 1948, establishing the WAFs (Women in the Air Force). Another barrier to professional advancement was removed in 1976 when women entered Air Force non-combat pilot training programs for the first time.

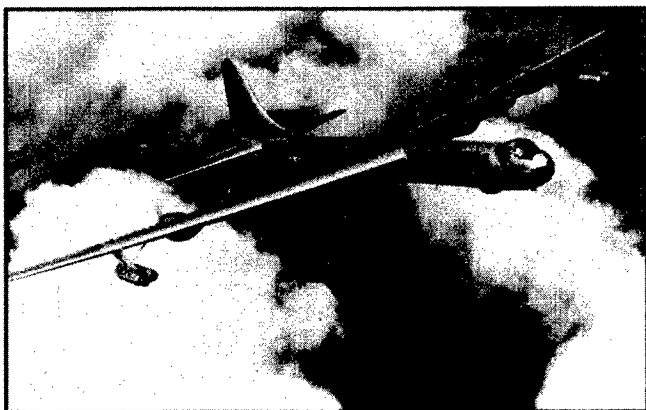
Atomic bombs carried by strategic bombers eventually ruled postwar Air Force and Department of Defense (DOD) war planning. Only aircraft such as the B-29 Superfortress, the B-36 Peacemaker, and the



WASPs (Women's Airforce Service Pilots) and Martin B-26 Marauders.

all-jet B-47 Stratojet, could carry atomic bombs that weighed upwards of 10,000 pounds (the Mark II-IV series). The Atomic Energy Commission (AEC), formed in 1946 to replace the wartime Manhattan Engineering District, succeeded in reducing the size of the bomb (the Mark 7 weighed 1,680 pounds) but did not change the basic atomic equation. A handful of Air Force bombers carried more power than all of history's armies and navies combined.

Under postwar demobilization, which affected the AEC just as much as the armed services, the nation's stockpile of atomic weapons rose to only nine in 1946. In 1947 the commission took over weapons-building programs and the stockpile reached thirteen as the Truman administration and the JCS discussed the level of production necessary to maintain an effective deterrent. In December 1947 the JCS approved a



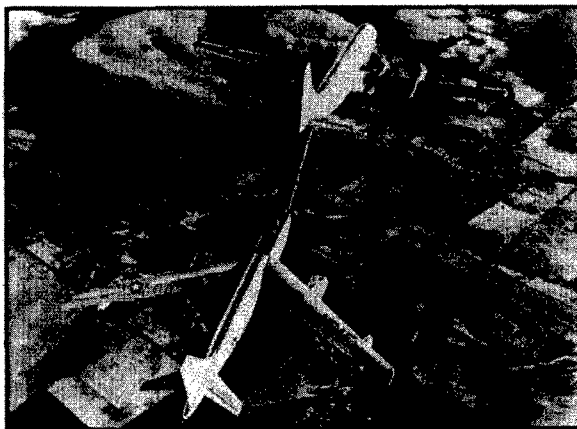
The enormous ten-engine Convair bomber, the B-36 Peacemaker, the largest aircraft ever to serve with the USAF. With atomic bomb-carrying capacity and intercontinental range, the B-36 was ordered in 1941 and debuted in 1946. When its J variant was retired in 1959 Strategic Air Command (SAC) became an all-jet force.

goal of 400 weapons for the AEC. At the same time, while SAC began to recover from the chaos of demobilization, its state of readiness remained low. Under General George C. Kenney and his deputy, Major General Clements McMullen, it assigned high priority to establishing a rigorous aircrew training program. This program, the secrecy that shrouded atomic weapons jealously guarded by the AEC, and the lack of information available to operational forces limited SAC's potential as an atomic strike force.

In addition, vast distances to targets challenged the skill and endurance of its aircrews. Although SAC operated the B-36 intercontinental bomber to strike anywhere in the world, it initiated the development of an aerial refueling capability in fall 1947. In 1948 it adopted the British hose method, converting some piston-engine B-29s to tankers, and formed two aerial refueling squadrons in June 1948. SAC later adopted the Boeing flying boom method of refueling, made standard in 1958. Using four aerial refuelings, the B-50 *Lucky Lady II* flew nonstop around the world between February 26 and March 2, 1949, to demonstrate the technique's global strike potential. Destined to serve Air Force jet bombers and fighters for the next four decades and beyond, the jet turbine-powered KC-135 Stratotanker, became operational in 1957.

The crisis that precipitated the Berlin Airlift began on June 24, 1948. It revolved around American plans for rebuilding a separate West German state and led the Soviet Union to initiate a ground blockade of the Western-controlled zones of Berlin, 90 miles inside Soviet-controlled East Germany. Forcing the blockade would have required the West to launch a general mobilization, fire first shots, and possibly set off another global war. Although the United States had deployed the conventional B-29 to Europe, perhaps in a calculated bluff that relied on the aircraft's reputation as an atomic delivery vehicle, the crisis continued. The Allies saw an opportunity to resupply Berlin and feed its 2.5 million beleaguered inhabitants by air through three air corridors guaranteed by agreement with the Soviet Union. Lieutenant General Curtis LeMay, then commanding U.S. Air Forces in Europe (USAFE), pieced together an airlift force of C-47 Skytrains left over from World War II, but the 80 tons per day they supplied were not enough. On July 30, 1948, Major General William Tunner, who had run the Himalayan "Hump" airlift during the war, replaced LeMay, the combat leader. Reinforced with four-engine C-54 Skymasters and C-74 Globe-masters, Tunner initiated around-the-clock flights guided by ground control approach radar. His aircraft landed every three minutes, carrying a record capacity of 5,620 tons per day. When the airlift appeared to succeed, the Soviet Union threatened to interfere with it.

President Truman responded by sending a wing of B-29s, widely described in the world press at the time as "atomic" bombers, to England. They were not, but the Soviet Union apparently believed they were and made no move to interrupt the airlift. In May 1949 it provided the United States with the first victory of the Cold War (without a shot being fired) when, after eleven months, 277,000 flights, and 2.3 million tons of life-sustaining supplies, it opened Berlin to surface traffic. A few months

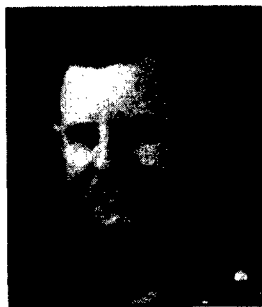


Aerial refueling. A Boeing KC-97 Stratofreighter nourishes a Boeing B-47 Stratojet, the USAF's first swept-wing jet bomber. The B-47, as capable as the B-29 and the B-36 of carrying atomic weapons, played important roles in SAC and the Cold War. Eighteen solid rockets mounted at the rear of its fuselage, which was dedicated almost completely to bomb and fuel containment, maximized takeoff performance. The B-47 served with the USAF from 1947 to 1969.

later in late August, it exploded an atomic bomb of its own, causing Americans grave national security concerns. Almost before the Truman administration could respond, it faced a new crisis in Korea.

Limited War In Korea

When North Korean forces invaded South Korea on June 25, 1950, in a surprise attack, they awakened the United States to the dangers of brushfire war in the nuclear age. The earlier crisis of 1948 in Berlin, Communist successes in Czechoslovakia in 1948 and China in 1949, and news of the Soviet explosion of an atomic device in 1949, had prompted the National Security Council (NSC) to issue a secret directive, NSC-68, in April 1950. It judged the Soviet Union to be bent on world domination. NSC-68 called for a massive increase in defense spending of 20 percent of the gross national product if necessary, the development of a hydrogen bomb, and the containment of Communism. The sustained American-led buildup of the North Atlantic Treaty Organization (NATO) in Europe was unmistakable evidence of containment, but Korea would be the first test of revitalized American resolve.



Principal American air commanders at the outset of the Korean War, Major General Earle Partridge, *left*, Fifth Air Force, and Lieutenant General George Stratemeyer, *right*, Far Eastern Air Forces (FEAF).

A heavy reliance on the nuclear strike force left the Air Force ill-prepared to deal with a conventional war on the other side of the globe. Moreover, when Congress approved the use of force to repel the North Korean invasion on June 30, 1950, the absence of a formal declaration of war introduced the Air Force to the new tribulations of limited war. The few air combat units of Major General Earle Partridge's Fifth Air Force, the main combat force of Lieutenant General George Stratemeyer's Far Eastern Air Forces (FEAF), launched interdiction raids against advancing North Korean units from bases in Japan in an attempt to slow their head-long rush down the Korean peninsula. Armed reconnaissance by fighters against targets of opportunity increased their effectiveness.

The United Nations (U.N.) Security Council had called on member nations to aid South Korea on June 27, but for a time, the U.S. Air Force's thin aluminum line was the only help harassed American and Republic of Korean ground forces could expect. B-26s of the 3d Bombardment Wing from Johnson Air Base in Japan put the interdiction effort on an around-the-clock basis with night intruder operations beginning on the night of June 27. B-29s of the 19th Bombardment Group, based at Kadena, Okinawa, added heavy bombs the next day. Continuing interdiction strikes (40 percent of all missions) against overextended North Korean supply lines and desperate ground action supported by air strikes (60 percent of all missions) saved U.N. forces trapped in the Pusan Perimeter. This success in direct support of U.N. troops freed Air Force units for strikes against strategic targets in North Korea. Accurate bombing in all weather conditions and North Korea's small size allowed the B-29s to all but eliminate its industrial base by September 1950.

General Douglas MacArthur, named Commander in Chief of the U.N. Command in Korea on July 8, launched a surprise amphibious land-

ing at Inchon on September 15, coupled with a U.N. drive north from the Pusan Perimeter, clearing South Korea of North Korean forces. In early October the U.N. changed its objective from saving South Korea to unifying all of Korea under a pro-Western government. Before the end of the month, as MacArthur's army approached the Yalu River separating China from North Korea, signs pointed to probable Communist Chinese intervention. The Air Force switched to interdicting the flow of men and materiel across the Yalu bridges. The freezing of the Yalu River in January 1951, and rules of engagement that forbade American overflights of Chinese territory on the north end of the bridges, condemned the effort to failure. B-29s had to fly above 20,000 feet to escape antiaircraft artillery fire from the Chinese side of the Yalu, but they could not fire back. That altitude and bombs errantly falling on Chinese territory insured little success. Bombing became even more difficult when China escalated the conflict in November 1950 by sending Soviet-provided MiG-15 jet fighters, launched from safe sanctuary on lightning attacks against American aircraft, especially FEAF B-29s. The airspace just south of the Yalu River in northwestern Korea became known as "MiG Alley." The performance advantages of the MiG-15 in speed and altitude initially held sway over propeller-driven P-51 Mustangs (pursuit aircraft redesignated by the Air Force as fighters in June 1948), jet-powered F-80 Shooting Stars, and even newer F-84 Thunderjets.

Chinese Communist forces counterattacked on November 26, driving U.N. units back toward South Korea. For the U.S. Air Force, this meant a renewed concentration on interdiction, combined with a campaign to maintain air superiority against the MiG-15s. Air Force airlift brought 1,600 tons of supplies to Marines cut off at Changjin (more widely known by its Japanese name, Chosin) Reservoir and evacuated 5,000 wounded. After retreating, U.N. forces stabilized along the 38th parallel in early 1951 and the war deteriorated into a series of small, bloody battles, with no significant movement by either side. War objectives changed again. Peace talks opened in July 1951. They were backed by a new American strategy to force high rates of attrition on the enemy. It would be up to FEAF, now under Lieutenant General Otto Weyland, and U.S. naval aviation to carry the war beyond the front, to pressure North Korea and China into a ceasefire, substituting air power whenever possible for ground operations that inevitably resulted in high casualties.

This strategy presented new threats and complications for the Air Force. Doctrine dictated strikes against the enemy's industrial fabric, but the bombing operations of 1950 had destroyed these limited North Korean targets. Industries supporting the Communist war effort, located in



Korean War fighters. North American F-86 Sabres, *top*, and Republic F-84 Thunderjets, *center*, challenged Soviet MiG-15s, *bottom*, sent into "MiG Alley" in northwestern Korea by Red China, to menace FEAF B-29s. Rules of engagement forbade the fighters from pursuing the MiGs across the border.

China and the Soviet Union, were off limits to aerial attack. The Air Force had to operate under the rules and restrictions of limited war and could not bring SAC's massive nuclear power to bear. FEAF B-29 Superfortresses, supported by tactical aircraft, bombed targets all over North Korea with conventional weapons, including radar-directed high-altitude strikes against enemy troops forming for attack. They blurred the lines between tactical and strategic air power, proving the value of George Kenney's "seamless" approach.

After China's intervention, both the United States and the U.N. sought a more limited objective, that of a negotiated truce. Dissatisfied,

MacArthur advised Congress that "there was no substitute for victory," and contradicted national policy. On April 11, 1951, President Truman fired MacArthur, replaced him with Matthew Ridgway, and in the process changed the nature of air warfare in Korea. The Air Force would still interdict the flow of supplies to Chinese units along the 38th Parallel and provide close air support to U.N. forces opposing them, but it would now also pressure the enemy into a settlement by inflicting maximum losses of men and materiel. The "police action" had become a war of attrition.

The Fifth Air Force's new commander, Lieutenant General Frank Everest, believed that interdiction was key to reducing the impact of Chinese offensives and U.N. ground losses. MiG-15s outnumbered F-86 Sabres over North Korea by five-to-one in 1951. Thus the Air Force's losses climbed as B-29s operated mainly at night. Complicating its air superiority campaign were air bases which the Chinese tried to build in North Korea to support their own forces and which FEAF was compelled to target. F-86s engaged MiGs in air-to-air combat and B-29s cratered the air bases' runways, forcing Communist jets to continue flying out of China and limiting their ability to challenge because of their short range. However, any bomb damage was quickly repaired by enemy labor units and necessitated continuous return missions. Interdiction, although costly, racked up long lists of destroyed trucks, trains, rail lines, and bridges, including the heavily-defended Yalu crossings. Nonetheless, supplies still reached Communist front lines in quantity by night. Medal of Honor recipient Captain John Walmsley, Jr., of the 8th Bombardment Squadron gave his life using his searchlight-equipped B-26 as a beacon to direct other B-26s while they bombed an enemy supply train on September 14, 1951. As it had in Operation STRANGLE in Italy during World War II, the Air Force learned that no air campaign was tougher than interdiction.

By the spring of 1952 the Chinese had won the battle of interdiction and the Americans had failed in their attrition strategy along the 38th Parallel. Communist representatives, first at Kaesong and then at Panmunjon, stalled peace talks and demanded mandatory repatriation for prisoners-of-war. General Weyland proposed to break the impasse by expanding the air war against North Korea. As U.N. casualties climbed and negotiations dragged on, the new American commander in Korea, General Mark Clark, accepted Weyland's proposal. In June 1952 he ordered the bombing of the Suiho Hydroelectric Complex, previously "off limits" and one of the largest facilities of its type in the world. It was a major exporter of electricity to Chinese industries across the border. A four-day onslaught over Suiho and other hydroelectric plants cost North Korea 90 percent of its power system. Through the remainder of 1952, the

Air Force attacked 78 cities and towns identified as supportive of a number of military functions, chiefly supply; however, to limit civilian casualties and weaken morale it alerted their inhabitants.

In Korea, as in World War II, the bombing of critical targets attracted the enemy's air force into the sky, where it could be engaged. Intelligence revealed that China had a thousand MiGs ready for combat and Fifth Air Force fighter squadrons, for the first time in the war, did not have to go hunting—the “game” came to them. A new version of the F-86, the F model, gave Air Force pilots superior performance to go along with their better training and tactics. In May and June 1953 the F-86Fs achieved a 133-to-1 advantage in combat kills over the MiGs. Individual scores rose, with Air Force Captain Joseph McConnell, a B-24 navigator in World War II, topping all pilots with 16 confirmed victories in only four months.

Three developments in 1953 brought peace to Korea. In March Soviet Premier Joseph Stalin, a major obstacle, died. In May, Air Force bombers increased the frequency of their attacks again, striking North Korean irrigation dams that, when breached, washed away railroads and highways and threatened the nation's rice crop. At the direction of President Dwight Eisenhower, Secretary of State John Dulles asked Indian Prime Minister Jawaharlal Nehru to warn China that the United States intended to use tactical and strategic nuclear weapons and might unleash SAC against Chinese cities if a settlement was not forthcoming. On May 27, 1953, China agreed to an armistice in Korea. It went into effect on July 27.

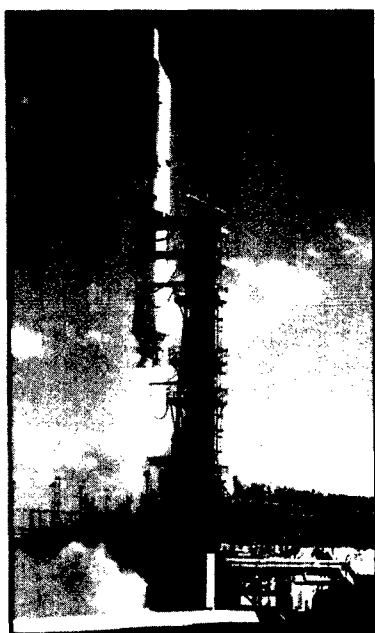
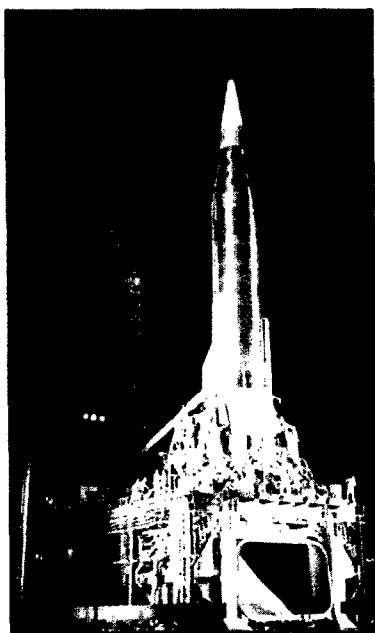
The Korean War should have taught the United States that nuclear weapons had limited use in conventional wars, but the appeal of the new hydrogen bomb, first tested in November 1952, and plans for a new all-jet intercontinental bomber, the B-52, continued to dominate strategic thinking. TAC sought a new generation of fighters (the “century series,” including the F-100 Super Sabre, F-101 Voodoo, F-102 Delta Dagger, F-104 Starfighter, F-105 Thunderchief, and F-106 Delta Dart) with supersonic speeds, but also adapted them to carry tactical nuclear weapons. The Air Force realized that while turbojet technology was the future, it alone was no substitute for good training, tactics, and aggressiveness. Military casualties in Korea of over two million for both sides, including more than 54,000 dead Americans, belied the judgment that this was a “limited” war—Americans learned firsthand the costs of war in Asia. Air Force aircraft had dropped 476,000 tons of explosives to achieve a standoff. Korea exposed the Air Force to the reality of post-

World War II warfare, where conventional (non-nuclear) air power would be used to "influence" an enemy, not to destroy it.

The "New Look" Air Force

After Korea, President Eisenhower told the JCS that the next war they planned would be nuclear. Conventional capabilities paled before super liquid deuterium bombs such as the Mark 17 (a 41,400-pound thermonuclear device). Only the Air Force B-36 Peacemaker and B-52 Stratofortress could carry the weapon. How to defend America against the Soviet Union's nuclear threat was the question of the day. Brushfire wars would be addressed when they arose, but, so the argument went, they should not occur under the threat of American nuclear retaliation. In January 1954, Secretary of State Dulles unveiled America's new defense strategy—the "New Look." The United States would deter any Soviet attack by threatening to destroy Soviet cities. Commanded by General Curtis LeMay, SAC would expand from 19 to 51 wings, armed with a new generation of smaller, but enormously destructive high-yield thermonuclear weapons. These wings would be placed on constant alert, based around the world, and eventually augmented by KC-135 turbojet Stratotankers to extend their aircrafts' range. In the mid-1950s the major portion of budgetary allocations to the Air Force went to SAC. This specified command, responsible for intercontinental nuclear retaliation, had become "an Air Force within an Air Force."

Besides acquiring such bomber aircraft as the B-52 Stratofortress and B-58 Hustler, the Air Force pursued missile development to support the "New Look." Beginning in 1946, Project MX-774 investigated the development of a 5,000-mile ballistic missile, however, the Scientific Advisory Group, formed by General Arnold, cautioned that atomic bombs were too large for any such delivery system and directed its efforts toward large, unmanned cruise missiles like the Snark. Ballistic missile development lagged until the test of the hydrogen thermonuclear bomb in November 1952 offered prospects of smaller warheads with greater power. Intensive research began in 1954, accelerating in 1956 when the DOD assigned the Air Force responsibility for all ground-launched missiles with ranges of more than 200 miles (later changed to 500 miles). Success with the liquid-propellant Thor and Jupiter intermediate range ballistic missiles (IRBMs, operational in June 1960 and April 1961, respectively) and Atlas and Titan I intercontinental ballistic missiles (ICBMs, deployed from September 1960 to December 1962 and April to



Atlas, *left*, and Titan I, *right*, intercontinental ballistic missiles were among several types that entered SAC's defensive inventory after the Korean War.

August 1962 respectively) came in time to carry a whole new generation of miniature nuclear and thermonuclear warheads. The solid-propellant Minuteman ICBM series followed, beginning in October 1962, and became the mainstay of SAC's missile retaliatory force. The U.S. Air Force was becoming an aerospace force.

Before ICBMs, manned bombers formed the strength behind the "New Look." Airmen had argued since World War I that air power was essentially offensive, but they were compelled to view it as defensive in light of the damage that resulted from the explosion of even one nuclear weapon. To detect incoming attacks, President Truman approved the Distant Early Warning (DEW) radar line which, with Canada's assent, was built across its northern territory beginning in 1954. To operate the line and coordinate their defensive forces, both the United States and Canada established on September 12, 1957, the binational North American Air Defense Command (NORAD). A generation of interceptor aircraft began service, beginning with the F-89 and F-100, succeeded by the F-102, F-106, and F-15. For a time anti-air defenses included surface-to-air missiles such as the Nike Ajax system. The development of several follow-up designs occurred, but none was deployed. In the early 1960s the Air Force reinforced NORAD with the Ballistic Missile Early Warning Sys-

tem (BMEWS) and, later, the Perimeter Acquisition Radar Characterization System (PARCS). An Air Force general officer historically has served as NORAD commander, operating from a command center inside Cheyenne Mountain near Colorado Springs, Colorado.

Because of its experience of World War II in Europe, the Air Force expressed little faith in the ability of America's defenses to stop a determined air attack, nuclear or otherwise. The only defense was deterrence, made possible by a protected force of bombers and missiles. Any strike at the United States would result in immediate, overwhelming retaliation and a smoking, radioactive wasteland. This "countervalue" strategy targeted cities. Because accuracy was limited, especially with early model ICBMs, and thermonuclear warheads were few, the Air Force targeted large, easy-to-hit cities to inflict the greatest possible damage. A countervalue strategy was at odds with the Air Force's traditional commitment to precision bombing, but consistent with Dulles's doctrine. Reliance on it and massive retaliation created three problems for the Air Force and the DOD.

The first problem had to do with the increasing vulnerability of manned bombers to improved enemy ground defenses when airborne and, when not, to a surprise nuclear first strike. The Air Force's solution to ground defenses was the production of standoff weapons (including the Hound Dog and eventually the SRAM short-range attack missile and ALCM air-launched cruise missile) to keep bombers at a distance from their targets. "Airborne alert" helped offset the threat of a surprise first strike against the United States. Beginning in 1957, part of SAC's bomber force always remained on ready alert, its crews on standby, poised to take



North American Air Defense (NORAD) command center inside Cheyenne Mountain, Colorado Springs, Colorado.

off at a moment's notice; another was dispersed to satellite bases around the world, complicating Soviet targeting; while a smaller was actually airborne. The DOD's ultimate solution was the Triad, maintaining three primary nuclear forces, each with special advantages. The first element of the Triad was the manned bomber, important for its load-carrying and ability to be recalled once launched. ICBMs formed the second component. They were important for their speed, size, and, eventually, accuracy. Early ICBMs, the Atlas and Titan I, burned cryogenic liquid propellant and required extended launch preparations which rendered them vulnerable to a first strike. In the 1960s later model Titans IIs employed storable propellants and, joined by the solid-propellant Minuteman, were placed in protective silos and capable of near-instantaneous launch. Submarine-launched ballistic missiles (SLBMs), including the Polaris, Poseidon, and Trident, comprised the third component of the Triad. Able to roam the world's oceans, missile submarines represented the most survivable of the three legs. Although the sub-launched solid-propellant ballistic missiles at first lacked range and accuracy, technology soon removed these drawbacks.

The second problem created by a countervalue strategy and massive retaliation had to do with the control and integration of diverse weapon systems into a single American war plan. In 1959 President Eisenhower ordered that a single integrated operational plan (SIOP) be adopted, which required coordination by the Army, Navy, and Air Force. The need for SIOP became apparent when in the late 1950s an investigation revealed that the military services had targeted Moscow with fewer than 170 nuclear bombs and warheads in case of all-out war.

The third problem had to do with intelligence. America's first steps into space, the "ultimate high ground," were associated with intelligence, surprise attack prevention, and nuclear war planning. The Air Force also sought to exploit space for communications, navigation, and weather forecasting.

Chuck Yeager and the XS-1 rocket aircraft, the first to break the sound barrier, began pushing back the aerospace frontier in 1947, as did other experimental aircraft that flew over 301,000 acres of desert testing ground in California at Edwards Air Force Base's Air Force Flight Test Center. The X-15 rocket airplane flew nearly seven times the speed of sound and seventy miles high in the mid-1960s—records that still stand for winged aircraft. In 1957 the Air Force began the Dyna-Soar program, later designated the X-20, to build a manned space boost glider/aerospace plane. Dyna-Soar was cancelled in 1963 in favor of a Manned Orbital Laboratory, itself scrapped in 1969 because automated satellites could



Chuck Yeager and the Bell XS-1 rocket aircraft, *Glamorous Glennis*, in which he became the first man to break the sound barrier in 1947.

perform the same missions. The flights of the X-aircraft, however, provided critical knowledge for manned space travel and for the special materials used in a new generation of aircraft, starting with the SR-71 Blackbird reconnaissance aircraft.

Strategic reconnaissance became the primary goal of space exploration. Fears of a surprise nuclear attack, based largely on the memory of Pearl Harbor, and the secrecy of events behind the Iron Curtain forced every administration after 1945 to seek information on the status and disposition of military forces inside the Soviet Union. Initially, U.S. Air Force and U.S. Navy aircraft were deployed along its vast periphery to take photographs and intercept radio and radar signals. In early 1956 the Air Force launched 448 unmanned camera-carrying balloons from western Europe propelled eastward by prevailing winds. Although inherently random in their coverage, 44 were recovered and provided tantalizing glimpses of some 10 percent of the Soviet Union's land area. At the direction of President Eisenhower, the Air Force, with the Central Intelligence Agency (CIA), and the Lockheed Aircraft Corporation developed the U-2, a single-engine glider aircraft capable of flying above 70,000 feet and beyond the range of Soviet air defenses. Eisenhower authorized U-2 overflights across the Soviet Union beginning on July 4, 1956, but, fearing that they might become a *casus belli*, he limited their number. Fewer than 25 missions occurred before a Soviet surface-to-air missile downed a U-2 flown by Francis Powers on May 1, 1960. The resulting diplomatic crisis ended aerial reconnaissance flights over the Soviet

Union. A more capable SR-71 Blackbird was soon available to replace the U-2, but by then safer "national technical means" were available for intelligence-gathering.

In part because of the Soviet Union's success with Sputnik in October 1957, President Eisenhower in early 1958 established within the DOD the Advanced Research Projects Agency, accelerating efforts to exploit space for reconnaissance purposes. The Air Force had begun investigating the use of satellites for this purpose as early as 1946, beginning actual development in October 1956 with a contract to Lockheed for the WS-117L (SAMOS) reconnaissance satellite. Dissatisfied with the technical prospects of the SAMOS, which transmitted images to Earth from space, in February 1958 Eisenhower approved Project CORONA, a CIA-Air Force effort to put into outer space a spy satellite capable of ejecting film capsules for retrieval on earth. The first CORONA satellite, known publicly as Discoverer, went into space on February 28, 1959, atop a modified Air Force Thor IRBM. After twelve consecutive failures, complete success came with number 14 on August 18, 1960. It provided analysts with film coverage of more of the Soviet Union than all of the U-2 flights combined. This first successful CORONA satellite ended the "missile gap" controversy, revealing that the Soviet Union possessed fewer IRBMs than the United States. Only a few SAMOS satellites were launched in the early 1960s. Designed to scan images in space and broadcast them as radio signals to receivers on the ground, SAMOS failed to return one usable photograph of the Soviet Union. Before leaving office



America's need for vital strategic reconnaissance increased in the Cold War period. The single-engine Lockheed U-2 glider aircraft was developed to overfly and gather information on the Soviet Union, principally. It attained altitudes above 70,000 feet. To mask the U-2's true purpose, the USAF at first designated it a "utility" vehicle.

in 1961, President Eisenhower established the National Reconnaissance Office to direct all U.S. reconnaissance efforts, with the Air Force and CIA participating. To provide satellite early warning of a nuclear attack, the Air Force also developed the Missile Defense Alarm System (MIDAS) and its operational successor, the Defense Support Program (DSP), that detected missiles within moments of their launch. DSP would later play a key role in detecting the launch of Scuds during the Gulf War.

After the discontinuence of the space reconnaissance mission, on March 28, 1961, Secretary of Defense Robert McNamara assigned the Air Force responsibility for other DOD military space operations such as the worldwide Defense Satellite Communications System I (DSCS I). Twenty-six system satellites were launched from 1966 to 1968. Beginning in 1972, larger geosynchronous communications satellites reinforced the original DSCS I, followed in the 1980s by a third generation of DSCS and in the 1990s by the Military Strategic Tactical and Relay Program (MILSTAR) system. Another key space flight project was the Defense Meteorological Satellite Program (DMSP) for monitoring weather conditions around the globe, with information transmitted to the Air Force's Global Weather Center at Offutt Air Force Base, Nebraska. The Air Force tracked and identified space debris produced by space missions through the Space Detection and Tracking System (SPADATS). The service also held primary responsibility for launching all DOD satellites at Cape Canaveral Air Force Station, Florida (into low inclination equatorial orbits) and at Vandenberg Air Force Base, California (into polar orbits).

Flexible Response and Vietnam

President John Kennedy initiated a more activist, interventionist national strategy in 1961, one that brought profound changes to the overwhelmingly nuclear-strike Air Force. The Kennedy administration authorized the expansion of the Air Force's ICBM arsenal to 1,000 Minuteman and 54 Titan IIs, deployed mainly at isolated bases in the north-central United States. The Navy nuclear component grew to 41 Polaris submarines, while the Army field forces eventually increased from 12 to 16 divisions and included a counterinsurgency capability. This expansion was intended to give the President increased flexibility in ordering a military response to international crises. In the Cuban missile crisis of October 1962, enormous American offensive power forced the Soviet Union to back down and prompted Secretary of State Dean Rusk to con-

clude, "We're eyeball to eyeball, and the other fellow just blinked." Kennedy had immense nuclear power at his disposal in confronting the Soviet Union over its nuclear missiles stationed in Cuba, but at the time he had few conventional options. His military choices were an invasion of Cuba, with no guarantees of success, or an all-out countervalue thermonuclear war. After the crisis, won through a third alternative, a naval blockade referred to as a "quarantine," Kennedy hastened to adopt the "flexible response" as America's new war-planning doctrine. SIOP-63 introduced the potential for limited nuclear war, while preserving the possibility of an all-out countervalue strike.

Even while the SAC-dominated Air Force eagerly adopted the Eisenhower administration's New Look structure, it also maintained forward-based units in Japan, Korea, Guam, the Philippines, and elsewhere on the Pacific rim. With almost 1,000 aircraft in place, these units came under the command of the Hawaii-headquartered Pacific Air Forces (PACAF), which replaced FEAFF as the air component of the Navy-led Pacific Command in 1957.

By 1957 the U.S. Air Forces in Europe (USAFE) had built up an even larger forward presence to bolster NATO. With more than 2,000 assigned aircraft of all types (not including SAC bombers also deployed in theater), USAFE's network of 32 primary installations stretched from England to Saudi Arabia. Reflecting NATO's "sword and shield" policy, USAFE focused on nuclear strike and air defense roles. By the time of the Berlin crisis of 1961, the command had shrunk in size, but it was quickly reinforced by the largest deployment of tactical aircraft since World War II. After the crisis eased, USAFE began a 20-year effort to improve its conventional capabilities in line with the flexible response strategy, which NATO officially adopted in 1967.

This flexibility increased the Air Force's responsibilities, which now ranged from waging all-out nuclear war to supporting the Army in limited conflicts. Tragically, the lessons of Korea had to be relearned in the skies over Vietnam. During the French Indochina War, as early as 1954, the JCS considered Operation VULTURE, in which the U.S. Air Force would be deployed to save the French army at Dien Bien Phu. The operation would involve nuclear and conventional bombing around the isolated French garrison. President Eisenhower vetoed this proposal, concerned, like General Omar Bradley during the Korean War, that this was "the wrong war, at the wrong place, at the wrong time, and with the wrong enemy." The Geneva Agreement of 1955 left Vietnam divided at the 17th Parallel into the Communist north under Ho Chi Minh, and the pro-Western south, under Bao Dai and Ngo Dinh Diem. The desire to contain

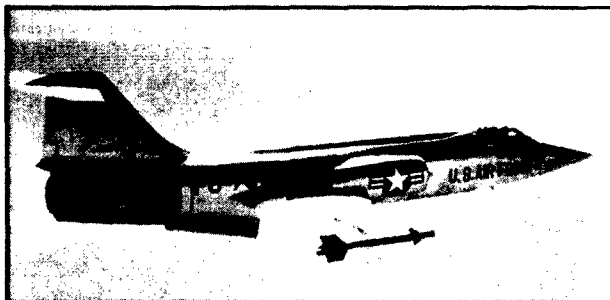
the spread of Communism brought about America's involvement in Vietnam. When President Kennedy declared that the United States would "pay any price, bear any burden, meet any hardship, support any friend, oppose any foe to assure the survival and the success of liberty," the stage was set. The Taylor-Rostow mission of October 1961 investigated the situation in South Vietnam and proposed the use of American air power against North Vietnam. Between 1965 and 1974 the United States would drop three times as many bombs in Southeast Asia as it did in all of World War II, but victory would prove even more elusive than in the Korean War.

Driven by its nuclear strategic bombing doctrine, the Air Force was ill-prepared for a limited war in Vietnam. Air Force training, technology, and strategy focused on general nuclear war with the Soviet Union. F-105 Thunderchief "fighters" had been designed to carry tactical nuclear weapons in an internal bomb bay, but were forced into use in Vietnam carrying 750-pound high-explosive bombs. F-104 Starfighters, the fastest fighters in the world, were designed to intercept Soviet bombers, but lacked the range and dogfighting ability to compete for air superiority over North Vietnam. Fortunately for the Air Force, the Navy had begun the development of two superb fighter-bombers, the F-4 Phantom II and the A-7 Corsair II, better suited to combat, although the absence of a machine gun in the former aircraft limited its usefulness as an air superiority fighter until the arrival of the gun-equipped E model.

U.S. Air Force aircrews flew combat missions in South Vietnam before 1964, but only if accompanied by South Vietnamese aircrews. The Gulf of Tonkin incident involving the Navy destroyers *C. Turner Joy* and *Maddox* in August 1964 resulted in a nearly unanimous Congressional vote of support for President Johnson "to take all necessary measures to prevent further aggression." As in Korea, however, there would be no declaration of war. Neutral sanctuaries in Laos and Cambodia would be off-limits to aerial attack for much of the conflict. Targets close to China and in Hanoi and Haiphong would also be off-limits for fear an expanded fight would lead to a direct confrontation between the United States and the Soviet Union and China, with the possible result of a nuclear holocaust. Vietnam would be another limited war. National objectives were, for the military, exasperating: "Don't lose this war, but don't win it, either." As President Johnson stated: "... not now, or not there, or too much, or not at all." The strategy was designed to hold off North Vietnam until South Vietnam became a viable nation able to defend itself. The Air Force would fight two wars—one against internal subversion by South

Vietnam-based Viet Cong, the other against North Vietnamese aggression.

The Air Force initially intended to destroy North Vietnam's industrial fabric and then to interdict its supplies to Viet Cong units in South



The Lockheed F-104 Starfighter, *above*, and the Republic F-105 Thunderchief, *below*. Although ill-suited to it, they were pressed into limited, rather than nuclear strategic conflict in Vietnam. The Starfighter interceptor, known as "the missile with a man in it," was one of the smallest aircraft ever to serve with the USAF. It could sustain speeds above Mach 2 and held the first ever simultaneous speed and altitude records. Its wings were extremely thin and small. The powerful Thunderchief was one of the most important weapons used in the bombing of North Vietnam. Its wings were sharply swept. Modifications that allowed it to carry anti-radar missiles gave it yet another mission.



Vietnam by attacking its railroads and ocean shipping and mining its harbors. Secretary of Defense Robert McNamara and Chairman of the Joint Chiefs of Staff Maxwell Taylor vetoed the air plan, however, because it might prompt Chinese or Soviet intervention. Like that in Korea, the strategy in Vietnam was to punish the enemy until it agreed to a ceasefire and peace, not to provoke the Chinese or Soviets.

The Air Force, they stated, would provide close air support for Army units operating in South Vietnam. The sustained bombing of North Vietnam began when circumstances changed in South Vietnam. On February 8, 1965, Operation FLAMING DART I launched tit-for-tat retaliatory bombings in response to enemy attacks on American installations in South Vietnam. Such an attack on the Pleiku Special Forces base resulted in limited air strikes against oil supplies and naval bases in North Vietnam. The strikes were intended to deter the enemy with the "potential" of American air power.

These circumscribed efforts gave Ho Chi Minh time to construct perhaps the strongest air defense network in the world at the time. Eventually, it included over 8,000 antiaircraft artillery pieces, over 40 active surface-to-air missile (SAM) sites, and over 200 MiG-17s, -19s, and -21s. Continued Communist ground action in South Vietnam brought the Air Force into the teeth of this network. Operation ROLLING THUNDER began in March 1965 and continued until October 1968. It was a frustrating air campaign marked by limits at every turn, gradualism, measured response, and, especially, restrictive rules of engagement. Doctrine drove the Air Force to strike against industrial web, but Air Force and Navy aircraft would be bombing a nation with a gross national product of \$1.6 billion, only \$192 million of which came from industrial activity. Like those of Korea, the industrial sources of North Vietnam's power were in China and the Soviet Union, beyond the reach of American air power.

ROLLING THUNDER's initial targets were roads, radar sites, railroads, and supply dumps. Because of bad weather the first mission of March 2, 1965, was not followed up until March 15. The Johnson administration did not permit attacks on airfields until 1967. SA-2 surface-to-air missile sites went unmolested; North Vietnam was permitted to establish SAM sites, and only *after* missiles were launched from them could they be attacked. Another rule restricted operations in a 30-mile zone and prohibited operations in a 10-mile zone around Hanoi. In 1965 and 1966 165,000 sorties against the North killed an estimated 37,000, but the war intensified in the South, with 325,000 American troops stationed there by the end of 1966.

In the summer of 1964, the JCS had proposed a list of 94 strategic targets as part of an intensified bombing campaign over which President Johnson and his advisers maintained careful control, assigning targets during Tuesday luncheon meetings at the White House. They doled out enough to pressure Ho Chi Minh but too many to prevent peace negotiations or to invite Soviet or Chinese intervention. Of the many bridges

bombed, the two most famous were the Thanh Hoa bridge eight miles south of Hanoi and the Paul Doumer bridge in Hanoi itself. Both were critical to transport supplies flowing from China into North and South Vietnam. Hundreds of bombing sorties conducted over several years failed to bring down the solidly-built Thanh Hoa bridge. When the Johnson administration finally permitted the bombing of the Doumer bridge in 1967, fighter-bombers quickly dropped one span. After several weeks, repair crews put the bridge back into operation and it had to be bombed again. Over France in World War I, American airmen contested with Fokkers for air superiority and over Germany in World War II, with Focke-Wulfs and Messerschmitts. Over Korea they fought MiGs. Over North Vietnam they fought fewer MiGs as the struggle became primarily directed against surface-to-air missiles and antiaircraft artillery. When the Johnson administration approved the cessation of bombing north of the 19th parallel in the spring of 1968, North Vietnam agreed to negotiate. Peace negotiations began in Paris in November 1968, and the United States halted ROLLING THUNDER. The JCS then limited Air Force operations in North Vietnam to protective reaction missions. Aircraft would conduct reconnaissance and would strike only if attacked.

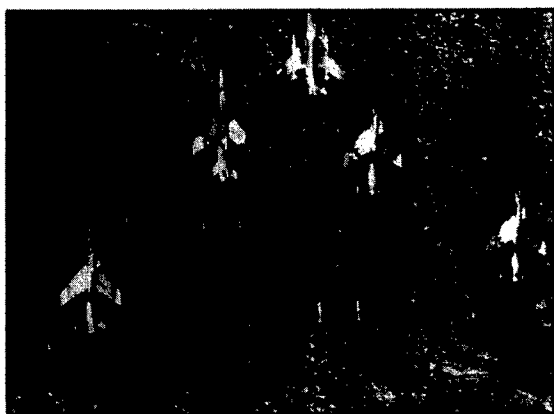
Meanwhile, in South Vietnam, the ground war worsened. In 1965 American commander, General William Westmoreland, oversaw the change of commitment in South Vietnam from a coastal enclave strategy for the protection of large cities, to direct ground involvement ("search and destroy" missions) into the interior after Communist forces in a massive campaign of close air support and interdiction. By 1968 over half a million American troops were engaged. Again, as it had in Korea, American strategy called for substituting air power for ground action whenever possible to reduce Army casualties. Ironically, while dropping less than one million tons of bombs on North Vietnam, the enemy, the United States dropped more than four million tons on South Vietnam, the ally. When Westmoreland ordered a major offensive into the "Iron Triangle" northwest of Saigon, more than 5,000 Air Force tactical strike sorties, 125 B-52 strikes, and 2,000 airlift sorties paved the way.

Operations included an extensive defoliation campaign (RANCH HAND) in which C-123 Providers and other transports sprayed 19 million gallons of herbicides over the jungles that provided convenient hiding places for Viet Cong guerrillas and North Vietnamese regular units out to ambush American ground troops. The overwhelming firepower brought by America to Vietnam gave Air Force airlift a major role in the war. Because jungle roads were rarely safe, Allied forces called on Army helicopters and Air Force C-47 Skytrains, C-119 Boxcars, C-123

Providers, and C-130 Hercules to move mountains of supplies around South Vietnam. C-141 Starlifters and C-5 Galaxies, augmented by commercial airlines, helped move in personnel and critical supplies from the United States.

Despite the fact that many targets were obscured much of the time by Vietnam's triple canopy jungles, the key to limiting ground casualties was close air support. As in earlier wars, the solution was to drop more bombs to inundate an area. Carpet bombing by B-52 Stratofortresses, each dropping up to 108 500- and 750-pound bombs, was the favored technique. Directed by LORAN, occasionally to within one thousand feet of American units, these ARC LIGHT missions flew at 30,000 feet. Bombs fell without warning. After the war, Vietnamese who survived this deluge described the ARC LIGHT experience as the most terrible they had faced. Another technique involved employing newly-developed gunships, including the AC-47 Spooky (known popularly as Puff the Magic Dragon), AC-119 Shadow, and AC-130 Spectre. The latter carried four 7.62-mm machine guns and four 20-mm cannon, each firing 6,000 rounds per minute, and 40-mm and 105-mm cannon. Orbiting over enemy concentrations at night, they covered the jungle with a rain of projectiles, well-appreciated by American soldiers nearby.

Again, as it had in Korea, the Air Force in Vietnam learned that the most difficult function of air power was interdiction; its major effort involved interdicting the flow of enemy troops and supplies down the Ho Chi Minh trail through Laos and Cambodia into South Vietnam. Many



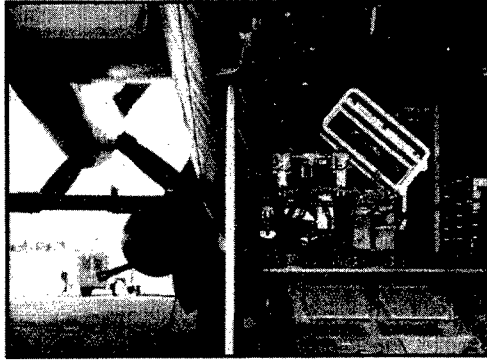
Aerial interdiction in Vietnam. Flying under radar control, four Republic F-105 Thunderchiefs and a North American F-100 Super Sabre release bombs over a North Vietnamese supply storage area hidden under a blanket of dense jungle.

Transport Aircraft in Vietnam



The USAF employed a variety of cargo aircraft in Vietnam. *Top to bottom:* The Fairchild C-123 Provider was fitted with special spray bars for jungle defoliation missions; the Fairchild C-119 Boxcar with its distinctive twin-boom construction, was designed with an unimpeded hold for large, bulky items and ground-level loading access; the Lockheed C-130 Hercules was used in rescue missions; the Lockheed C-141 Starlifter was the first pure jet transport; and the gargantuan Lockheed C-5 Galaxy had a 28-wheel undercarriage and furnished the farthest transport of the service's heaviest loads.

targets were merely geographical coordinates superimposed over the vast green jungle of Southeast Asia. Others were the smoke and dust kicked up by enemy forces as they moved down the trail by day. At night, they were campfires, hot engines, and other man-made infrared signatures picked up by airborne sensors. Fighters soon compelled the enemy to move only by night, when gunships took over. But using \$10 million aircraft to destroy \$10,000 trucks was no solution. Three Soviet ZIL-157 six-wheel drive trucks or 400 bicycles carrying 75 pounds each could provide the fifteen tons of supplies to Communist forces in South



A close up rear view of an AC-130 gunship at Ubon Air Base, Thailand, showing both the interior and exterior positioning of a 105-mm howitzer.

Vietnam each day. More came from plundered American and South Vietnamese storehouses.

On January 30, 1968, enemy units launched the Tet Offensive, striking cities and other targets throughout South Vietnam. In February alone, Air Force units launched 16,000 strike sorties in support of ground operations, helping to blunt the offensive. The focus of the Air Force's operations, however, was the besieged firebase at Khe Sanh, where 6,000 Marines faced three North Vietnamese divisions. President Johnson told General Westmoreland that he did not want another "damn [Dien Bien Phu]." Air power would have to hold off Communist attacks. Three months of Operation NIAGARA totaled 24,000 fighter-bomber and 2,700 B-52 strikes, 110,000 tons of bombs, and nightly assaults by gunships. Additionally, the Air Force airlifted 12,000 tons of supplies to the surrounded Marines. Air power guaranteed that there would be no repeat of the French disaster at Dien Bien Phu.

The Tet offensive proved a military defeat for the Communists, who lost between 50,000 and 80,000 soldiers, but it represented a political victory that galvanized the antiwar movement in the United States. It led many other Americans to question the war's objectives, especially in the face of General Westmoreland's announcement just before its launching that he could see "the light at the end of the tunnel." The Tet offensive (and a poor showing in the New Hampshire primary) convinced President Johnson not to run for reelection. It also brought to the Oval Office a new president, Richard Nixon, committed to ending American involvement in the war and turning it over to the South Vietnamese. F-5 Freedom Fighters strengthened the South Vietnamese Air Force while Nixon withdrew American ground units. On March 30, 1972, the North Vietnamese Army invaded South Vietnam with 12 divisions from the north and west. Although South Vietnamese forces were no match for the invaders, the Spring offensive was a major miscalculation. American ground forces were gone, but U.S. Air Force and U.S. Navy aviation remained. For the first time in the war, the Air Force was up against the kind of conventional war it could win. Eighteen thousand fighter-bomber and 1,800 B-52 sorties stiffened South Vietnamese resolve. In the desperation of the moment, fighter pilots found themselves aiming 2,000-pound laser-guided bombs at Communist tanks—not cost effective, but effective nevertheless. The massive employment of air power bought more time for South Vietnam.

Although American air power had repelled the invasion, implications for Nixon's Vietnamization strategy were clear. American hopes for ending the war revolved around the Air Force's applying greater pressure on North Vietnam to influence its negotiators to return to the Paris peace talks. The LINEBACKER I bombing campaign from May to October 1972 was a major escalation of the war and included the mining of Haiphong and other ports. Bridges that had resisted bombing now fell before precision laser-guided and electro-optically-guided bombs. Before LINEBACKER, peer pressure and pride drove American aircrews, even as they asked: "What the hell is this all about?" During LINEBACKER they had a clear and limited objective—forcing the regime in Hanoi back to Paris.

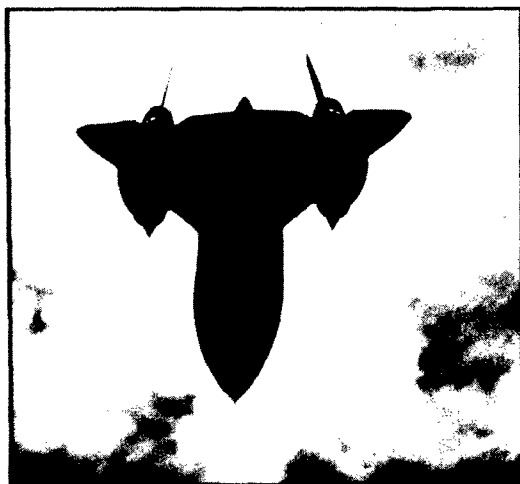
In Paris some progress was made, but in December 1972 Communist negotiators became recalcitrant. Their delaying tactics prompted President Nixon to order the most concentrated bombing campaign of the war—LINEBACKER II. For 11 days beginning on December 18, with a Christmas break, SAC B-52s struck at rail yards and other targets in the outskirts of Hanoi and Haiphong. On the first mission, 129 B-52s pene-

trated the area, supported by a wide array of Air Force and Navy aircraft. F-4s dropped chaff in wide corridors. EB-66s, EA-3s, and EA-6s jammed enemy radar with electronic countermeasures. F-105 Wild Wea-



LINEBACKER I and II operations, 1972. In missions carried out from May to October and in December to compel enemy negotiators back to the Paris peace talks, intercontinental Boeing B-52 Stratofortresses, *top*, form up to take off for intensive bombing missions over North Vietnam. A General Dynamics variable-sweep wing F-111 tactical fighter, *center*, provides high-precision bombing. The aerial photograph of a military weapons storage area, *bottom*, in Hanoi reveals widespread bomb cratering and demolished buildings.

sels with Shrike radar-seeking missiles attacked enemy radar sites. SR-71s provided reconnaissance. EC-121s fed early warning information to the attacking aircraft. F-4s, A-7s, and F-111s struck airfields, storage sites, and other precision targets. F-4s flew MiG suppression. KC-135s orbited over the Gulf of Tonkin, ready to feed thirsty jets. This was the air war the Air Force had wanted from the beginning. A B-52 tail



The Lockheed SR-71 Blackbird strategic reconnaissance aircraft, first employed during the Vietnam War. A marvel of technology, it outperformed all of the other military aircraft of its time, attaining altitudes above 85,000 feet and speeds of nearly Mach 3.5.

gunner shot down a MiG on the first night, but 200 surface-to-air missile launches claimed three B-52s—the first 3 of 15 lost.

By December 27 North Vietnam had depleted its supply of SA-2 missiles and much of its antiaircraft ammunition. Interdiction strikes against rail lines and bridges coupled with mines in Haiphong Harbor prevented resupply from China or the Soviet Union. By December 30, LINEBACKER II had destroyed many industrial and military targets in the Hanoi and Haiphong area, although its major impact was on North Vietnam's morale. To Captain Ray Bean, an F-4 crewman imprisoned in the "Hanoi Hilton," the B-52s "got the attention of the North Vietnamese" because the United States seemed to have forsaken precision attacks on purely military and industrial targets in favor of "whole-sale destruction." North Vietnam witnessed the path of devastation a single B-52 could create, especially in an urban environment. Its negotiators returned to the peace talks, agreeing to a cease-fire in January 1973 and signing a treaty in April. Before the year was out Congress cut funds for Southeast Asian operations and passed the War Powers Act, which limited the President's options.

Two years later North Vietnam launched a final offensive against a South Vietnam operating without American air support. After 55 days, on April 29, 1975, Saigon fell. In Vietnam, the United States lost 58,000

men and women. The war helped cause a decade of inflation and alienated a generation. The Air Force had invested over 1.2 million fixed wing sorties, 6.2 million tons of explosives, 2,118 dead, 599 missing in action, and 2,257 aircraft (at a cost of \$3.1 billion).

The Air Force learned the dangers of political and military micro-management, of gradualism, and of being used to influence the conduct of America's enemies instead of defeating them. Restrictive rules of engagement caused aircrews to die and left little room for initiative. "Route packages," artificial divisions of North Vietnam in which Air Force and Navy aircraft operated separately, guaranteed a dilution of effort. A generation of future air leaders came away convinced that "body counts," sortie rates, and tons of bombs dropped were all poor means for judging air power's effectiveness. They also relearned the importance of air superiority, but with a twist—air superiority now involved not only overcoming an enemy's air force; it involved also overcoming an enemy's air defenses on the surface. Air power had to be focused, united, and coordinated in what was termed "jointness" after the war.

Most of all, the Air Force learned the dangers of strict, uncompromising adherence to doctrine. In the years after Vietnam a new generation of air leaders realized that the Air Force had focused almost exclusively on the strategic bombing of industrial chokepoints without regard for the character of the society to be bombed or the type of war to be fought. Training, technology, and doctrine revolved around the destruction of a developed nation's industrial fabric or the nuclear destruction of a nation's cities. The Air Force had become imprisoned by a doctrine established in the years before and after World War II. Applied against undeveloped states such as North Korea and North Vietnam, each equipped and supplied by other countries, and unable to use nuclear weapons because of the Cold War and moral considerations, strategic bombardment and its related strategies did not prevail.

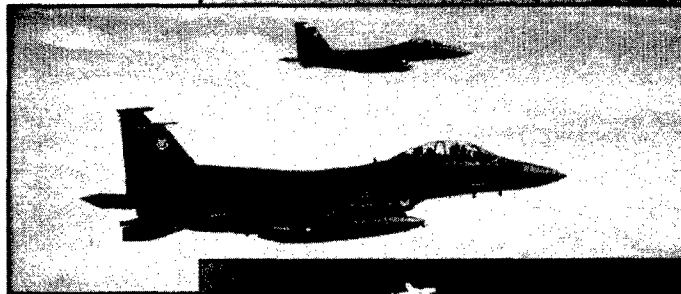
The Cold War Concluded

President Kennedy's flexible-response nuclear war-fighting doctrine of the early 1960s lacked the technology to match its vision of many options adapted to meet the varieties of Cold War crises. Advances in geodesy and cartography and the integrated circuit developed in the early 1960s for missile and satellite guidance systems, significantly improved missile accuracy. Decreased CEP (circular error probable—the radius of a circle in which at least 50 percent of the targeted missiles would hit)

meant that warheads could be smaller. New warheads could be sized to detonate at kiloton or megaton ranges independently. Because they were smaller and lighter, more warheads could be mounted to each ICBM and SLBM. In the early 1970s the DOD developed MIRVs (multiple independently targetable reentry vehicles), allowing three or more warheads on each ICBM and SLBM. The Air Force's arsenal did not rise above 1,054 ICBMs; many now carried three MIRVs (Minuteman III) as opposed to earlier models that carried a single Minuteman I or II warhead. Strategic launchers remained static, but warheads multiplied.

Although Secretary of Defense McNamara introduced "counterforce" targeting in 1962, the improvement in CEP and dramatic increases in the number of nuclear warheads in the American arsenal of the 1970s encouraged the Air Force to return to the more traditional practice of bombing precise military targets instead of countervalue cities. Counterforce targeting identified enemy military and industrial choke-points—command centers, military industries and bases, and ICBM silos. Whatever the targets selected, in the 1960s political leaders adopted a doctrine for deterring nuclear war known as "assured destruction," i.e., the capability to destroy an aggressor as a viable society, even after a well-planned and executed surprise attack on American forces. This doctrine held that superpower strategic nuclear forces would be sized and protected to survive a nuclear attack and then to retaliate with sufficient force to ensure a level of destruction unacceptable to the other side. With such retaliatory destruction assured against an aggressor, no rational Soviet or American leader would consider starting a nuclear war. On May 26, 1972, the United States and the Soviet Union signed the Anti-Ballistic Missile (ABM) Treaty, which limited both sides to two ABM sites each to protect the national capital and an ICBM complex. The treaty reinforced the continued effectiveness of assured destruction in deterring war in the face of new, destabilizing ABM weapons. SALT I, the Strategic Arms Limitation Treaty which was signed at the same time, limited the numbers of nuclear weapons with the objective of obtaining a verified freeze on the numerical growth and destabilizing characteristics of each side's strategic nuclear forces.

The Nixon administration adopted counterforce targeting beginning with SIOP 5 of 1974. The Carter administration expanded it with Presidential Directive 59 and SIOP 5D. Counterforce, however, offered an option to assured destruction of a limited, prolonged nuclear war based on accurate attacks with limited collateral damage while maintaining a creditable second strike capability. In an address on March 23, 1983, President Ronald Reagan proposed replacing the doctrine of assured destruc-



The Fairchild A-10 Thunderbolt, *top*, the McDonnell Douglas F-15 Eagle, *center*, and the General Dynamics F-16 Fighting Falcon, *bottom*. These attack and fighter aircraft armed with missiles, cannon, and various electronic countermeasure (ECM) features have been in service since the 1970s and performed outstandingly in the Gulf War.

tion with one of assured survival, in the form of the Strategic Defense Initiative (SDI). SDI was to focus on the development and deployment of a combination of defensive systems such as space-based lasers, particle beams, railguns, and fast ground-launched missiles, among other weapons, to intercept Soviet ICBMs during their ascent through the Earth's outer atmosphere and their ballistic path in space. While the ABM Treaty restricted various methods of testing SDI weapon systems, the end of the Cold War and collapse of the Soviet Union removed the justification for the level of research and development associated with this project, although research continued at a much reduced level under the Ballistic Missile Defense Organization.

Beginning in March 1985, Soviet Communist Party General Secretary Mikhail Gorbachev initiated major changes in Soviet-American relations. The Intermediate Range Nuclear Forces Treaty in December 1987 eliminated short-range nuclear missiles in Europe, including Air Force ground-launched cruise missiles stationed in the United Kingdom. Gorbachev's announcement in May 1988 that the Soviet Union, after nine years of inconclusive combat, would begin withdrawing from the war in Afghanistan, indicated a major reduction in Cold War tensions, but it provided only a hint of the rapid changes to come. Relatively free and open Russian elections in March 1989 and a coal miners strike in July shook the foundations of Communist rule. East Germany opened the Berlin Wall in November, which led to German reunification in October 1990. A coup against Gorbachev in August 1991 by Boris Yeltsin, led to the dissolution of the Soviet Union and its replacement by the Commonwealth of Independent States on December 25, 1991.

This chain of events brought major changes to American nuclear strategy. Under START I, the Strategic Arms Reduction Treaty signed by the United States and the Soviet Union in July 1991, the Air Force will be involved in reducing to a level of 6,000 total warheads on deployed ICBMs, SLBMs, and heavy bombers. START II, signed in January 1993, will reduce (upon entry into force) total deployed warheads to a range of 3,000 to 3,500. The resulting force structure (determined during the Nuclear Posture Review process overseen within his department by then Secretary of Defense Les Aspin), will ultimately lead to the deployment of five hundred single warhead Minuteman III ICBMs, 66 B-52H and 20 B-2 heavy bombers. Ninety-four B-1 heavy bombers will be reoriented to a conventional role by 2003, in addition to all Peacekeeper ICBMs being removed from active inventory through the elimination of their associated silo launchers. The Air Force, by Presidential direction in September 1991, notified SAC to remove heavy bombers from alert status. SAC was subsequently inactivated several months later in June 1992. U.S. Strategic Command replaced Strategic Air Command, controlling all remaining Air Force and Navy strategic nuclear forces.

Rebuilding the conventional Air Force after Vietnam began with personnel changes. The Vietnam-era Air Force included many officers and airmen who had entered its ranks in World War II. President Nixon ended the draft in 1973 in favor of an "all volunteer" American military. The Air Force attracted recruits as best it could, but encountered problems with the racial friction and alcohol and drug abuse that reflected America's social problems. Enough Vietnam career veterans remained, however, to direct the new service and institute changes, one of the most

noticeable of which was more realistic, and thus more dangerous, combat training. In combat simulations Air Force pilots flew as aggressors employing enemy tactics. By 1975 their training had evolved into Red Flag at the U.S. Air Force Weapons and Tactics Center at Nellis Air Force Base in Nevada, in which crews flew both individual sorties and formations in realistic situations, gaining experience before they entered actual combat.

The vulnerability of air bases to enemy attack and sabotage had long been the Achilles heel of land-based air power. In western Europe, living under the threat of a massive Warsaw Pact air offensive and land invasion, the U.S. Air Force spearheaded an active program to improve the survivability and readiness of air bases. The effort was marked by the construction of thousands of reinforced concrete aircraft shelters and other hardened facilities, alternate runways, rapid repair elements, chemical weapons protection, and a host of other defensive measures.

The Air Force's post-Vietnam rebuilding also involved applying improved technology. The battle for control of the skies over North Vietnam underscored the need for a dogfighting aircraft that featured maneuverability before speed—one armed with missiles *and* cannon. Begun in the late 1960s and operational in the mid-1970s, the F-15 Eagle and the F-16 Fighting Falcon filled this need. The struggle against radar-guided anti-aircraft artillery and surface-to-air missiles in Vietnam encouraged the Air Force to pursue stealth technology utilizing special paints, materials, and designs that reduced or eliminated an aircraft's radar, thermal, and electronic signatures. Operational by October 1980, both the B-2 stealth bomber and the F-117 Nighthawk stealth fighter featured detection avoidance.

Other Vietnam War technologies included precision guided missiles and bombs. From April 1972 to January 1973 the United States used over 4,000 of these early "smart weapons" in Vietnam to knock down bridges and destroy enemy tanks. Continued development of laser-guided bombs and electro-optically-guided missiles offered the prospects of pinpoint, precision bombing on which traditional Air Force doctrine rested—the destruction of chokepoints in an enemy nation's industrial web with economy of force and without collateral damage. These technologies, which afforded a strike precision far beyond that available to earlier air power thinkers, sparked a revision of the traditional doctrine of strategic bombing. This revision took two forms. First, the Air Force, to overcome numerically superior Warsaw Pact forces, cooperated with the Army in updating the tactical doctrine of AirLand Battle promulgated in Field Manual 100-5 in 1982. The Air Force would make deep air attacks

on an enemy army to isolate it on the battlefield, conduct battlefield air interdiction (BAI) to disrupt the movement of secondary forces to the front, and provide close air support (CAS) to Army ground forces. The Air Force procured the A-10 Thunderbolt II CAS attack-bomber in the 1970s to support such missions.

Second, the Air Force pursued a new approach to conventional strategic bombing doctrine in the fertile atmosphere of the post-Vietnam era. Key leaders in the effort were Generals Charles Boyd and Charles Link and Colonel Dennis Drew. Strategic bombing doctrine of the Air Corps Tactical School, World War II, Korea, and Vietnam had relied on carpet bombing to saturate linear chokepoints, with industry as the key. Colonel John Warden's ideas in the Gulf War relied on precision munitions to attack an expanded complex of targets. He viewed an enemy nation's war-making capacity in five concentric rings. The center ring consisted of its civilian and military leadership, the first ring out, its key production sources, the second ring out, its transportation and communication infrastructure, third ring out, the will of its population, and, the last ring, its military forces. An air attack on these would be "inside-out" warfare, starting from the center and working outward. The first objective of an air war would be to seize air superiority followed by attacks on an enemy's leadership and other vital centers. Colonel John Boyd focused on "control warfare" and "strategic paralysis" by loosening the observation, orientation, decision, and action loops (the "OODA Loop") that maintained the "moral-mental-physical being" of an enemy nation.

Participation in three crises in the 1980s allowed the Air Force to test these new ideas and technologies. Operation URGENT FURY (October 1983) rescued American students and restored order on the island of Grenada. In this operation the Air Force primarily transported troops and cargo, but discovered problems with command, control, planning, and intraservice and interservice coordination. President Reagan called on England-based F-111s to strike against Libya on April 19, 1986, in support of his policies to counter state terrorism. Operation ELDORADO CANYON exposed continuing difficulties with target identification and intelligence, punctuated by some inaccurate bombing. Finally, Operation JUST CAUSE in 1989 again tested air operations, this time in Panama. The Air Force provided the airlift for troops and supplies, although the F-117 Nighthawk stealth fighter made its debut when it and an AC-130 Spectre gunship intimidated Panamanian troops loyal to the dictator Manuel Noriega.

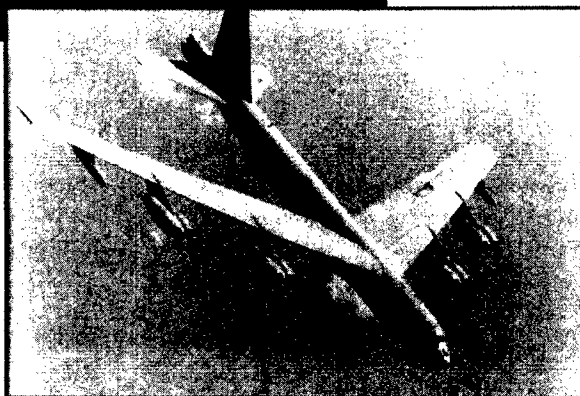
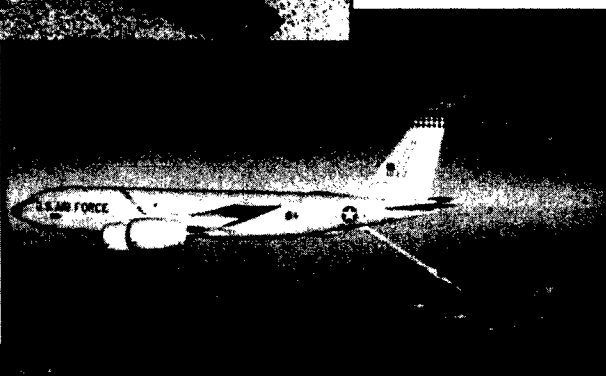
Air Power Triumphant—The Gulf War

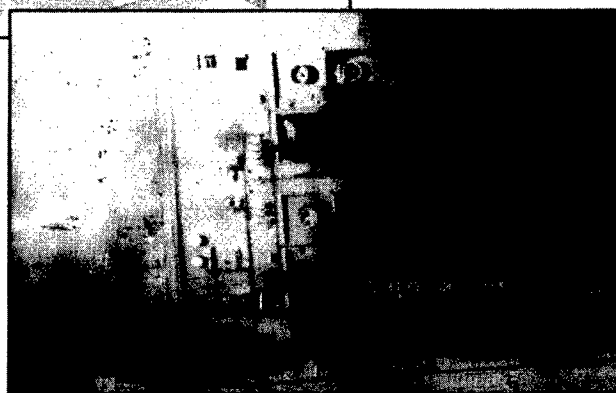
The U.S. Air Force found itself in a third major war since 1945 when, on August 2, 1990, forces led by Iraqi President Saddam Hussein, seized Kuwait and began a conflict that differed considerably from those in Korea and Vietnam. The ending of the Cold War had eliminated concerns about an expanded war and the client support Iraq might have expected from the Soviet Union. Flexibility of doctrine, technology, leadership, and training allowed the Air Force to adjust to the unique components of the Gulf War—a desert battlefield, a loosely united coalition (including several Arab nations desiring minimal damage to Iraq), and an American people strongly opposed to a prolonged war and resulting heavy casualties. A first phase, Operation DESERT SHIELD, the defense Saudi Arabia and its huge oil reserves, began on August 6, when Saudi Arabia requested American assistance. Two days later F-15C Eagles from the First Tactical Fighter Wing, supported by E-3B Sentry airborne warning and control aircraft, arrived in the Persian Gulf—a first step in the rapid relocation of one-quarter of the Air Force's total combat inventory and nearly all of its precision bombing assets. Military airlift, including the Civil Reserve Air Fleet, rapidly moved 660,000 Coalition personnel to the area, although most supplies and equipment came by sea. Turbojet-powered C-141 and C-5 military transports operating between the United States and the Persian Gulf carried ten times more tons of cargo per day than all of the piston-engine transports designed for commercial traffic carried during the entire Berlin Airlift. That distance insured that U.S. Air Force KC-135 and KC-10 tankers would play a critical role in a war that required more than fifteen hundred aerial refuelings per day. Fortunately, Operation NICKEL GRASS, the aerial resupply of Israel during the October 1973 War, had revealed the need to equip Air Force C-141 cargo aircraft with inflight refueling capabilities, extending airlift's range in time for the Gulf War.

The second phase was Operation DESERT STORM, the liberation of Kuwait and the reduction of Iraqi military capabilities, especially its nuclear, chemical, and biological weapons. The U.N. coalition opposing Hussein depended primarily on air power to hammer enemy forces and achieve its objectives while minimizing casualties. The U.S. Air Force flew nearly 60 percent of all fixed-wing combat sorties in support of DESERT STORM, dropping 82 percent of precision guided weapons.

The air offensive began at 0238 local time, January 17, 1991, with night attacks on Iraqi early warning radar sites, Scud short-range ballistic missile sites, and communication centers, including the interna-

America's Air War in the Gulf





Stars of the Gulf War, *opposite, top to bottom*: Spectacularly demonstrating the value of stealth technology, the Lockheed F-117 Nighthawk fighter performed almost perfectly. The KC-135 Stratotanker's latest version provided necessary aerial refueling over huge distances, and Boeing E-3 Sentry Airborne Warning and Control Systems (AWACS) aircraft ensured the Allied air supremacy that won the day over Iraq. Making yet another vital contribution over the battlefield, the venerable B-52, the USAF's longest-serving aircraft, provided heavy, high-altitude bombing capability. The USAF effectively rendered useless massively reinforced concrete aircraft shelters, such as those *above, top and center*, and vital oil production and storage facilities, *bottom*, with bombing precise enough to leave little collateral damage.

tionally-televised attack by two F-117A Nighthawks on the so-called AT&T communications building in downtown Baghdad. Air Force and Navy cruise missiles hit additional targets, including government buildings and power plants. It was the beginning of a thirty-eight day aerial offensive consisting of four phases: a strategic campaign against Iraq, an air superiority campaign, an effort to weaken Iraqi ground units in Kuwait, and, eventually, close air support for the ground offensive. Over 2,000 combat aircraft in the Coalition inventory struck targets in all four components to be struck simultaneously. Contrasted sharply with the 12 sorties Eighth Air Force launched on August 17, 1942, in its first strike against German targets in World War II, the Coalition flew 2,759 combat sorties on day one of the Gulf air offensive.

The air war defied easy analysis because of simultaneous strikes against targets in all of Warden's concentric rings. In past wars identifiable campaigns were mounted against various kinds of targets—ball bearing, aircraft assembly, oil production, transportation, irrigation, power dams, or interdiction, but in the Gulf War such attacks and more were mounted concurrently. Unlike AWPD planners of 1941, Gulf War planners did not have to choose between target categories—they selected targets from among all categories. Coordinating the two or three thousand sorties required per day was the responsibility of Lieutenant General Charles Horner, the Joint Force Air Component Commander (JFACC). He controlled all aircraft in the theater except those of the Navy in sorties over water, those of the Marines supporting their own ground units, and helicopters flying below five hundred feet. The lesson of conflicting responsibilities, priorities, and command and control represented by the "route packages" of Vietnam had been learned well. Despite problems with intelligence and communication between the diverse Coalition air forces, never had there been such a carefully directed air campaign.



Lieutenant General Charles Horner, Joint Force Air Component Commander (JFACC) for Operation DESERT STORM, ran the coalition air war.

Air superiority came quickly, as Saddam Hussein ordered his air force not to compete for command of the skies. His plan was to absorb any air blows and force the Coalition into bloody trench warfare, in the "mother of all battles." Losses to Coalition attackers on the first night were limited to one Navy F/A-18. Considering the quantity and quality of the forces arrayed against Iraq, Hussein's withholding of his Air Force was perhaps appropriate. Coalition air forces shot down only 32 of 700 fixed-wing combat aircraft in the Iraqi Air Force (27 by the U.S. Air Force), although they destroyed many more on the ground. There would be no air aces in this war. Rules of engagement that allowed the firing of missiles at enemy aircraft beyond visual range aided Coalition success against the few Iraqi jets rising to do battle. Pressed by U.S. Air Force attacks on their protective shelters, more than one hundred Iraqi aircraft fled to safety in neutral Iran. The struggle for control of the air was primarily against Iraqi ground defenses, which absorbed many Coalition strikes. These included 122 airfields, 600 hardened aircraft shelters, 7,000 antiaircraft guns, and 200 surface-to-air missile batteries.

Never had the world seen such a variety of bombing targets and aircraft. Air Force crews dropped laser-guided bombs down air shafts in hardened buildings and on oil tank valves when Saddam Hussein ordered millions of gallons of oil poured into the Persian Gulf. They "plinked" tanks with laser-guided and electro-optically guided bombs and missiles. They carpet-bombed Iraq's Republican Guard divisions from high altitude in B-52s. Coalition aircraft, including more than 70 distinct types from ten countries, struck at command, control, and communications centers, bridges, oil refineries, air defense facilities, radar sites, nuclear weapon production facilities, chemical and biological production facilities, electrical production facilities, weapons production facilities, missile launch sites, ports, and others. There were plenty of targets. The initial INSTANT THUNDER air plan for the strategic bombing of Iraq identified 84 to be hit in less than a week. By the start of the air war on January 17, however, the Coalition target list had increased to 481, compared to the 154 of World War II's AWPD/1.

The most sensitive targets were in Baghdad, defended by the heaviest concentration of antiaircraft weapons. The world press observed Coalition strikes there and reported collateral damage and civilian casualties with special interest. General Horner limited these most dangerous and most critical attacks to Air Force F-117 stealth fighters flying by night and Navy Tomahawk cruise missiles striking by day and night. The stealthy F-117 Nighthawk fighters proved most valuable to Coalition success, bombing 40 percent of strategic targets in Iraq while flying only

2 percent of combat sorties. Their favorite weapon was the laser-guided bomb, which although amounting to less than 5 percent of all bombs dropped, accounted for most of the key targets. Precision guided munitions and F-117s proved their value as "force multipliers," increasing the impact of the bombing campaign. Their strikes were not completely free of political interference, however, as President Bush made Baghdad off-limits to bombing for a week after two laser-guided bombs hit the Al Firdos Bunker on February 13, a command structure also used as an air raid shelter by civilians. The attack left hundreds dead.

The Iraqi army mounted Scud surface-to-surface ballistic missiles on small, mobile launchers. Hidden in civilian traffic, and fired at night, the Scud counteroffensive proved nearly unstoppable, although Iraq launched only eighty eight of these weapons during the war. One Scud landed in Dhahran, Saudi Arabia, and killed twenty-eight American soldiers, the deadliest single action for the United States during the war. Like the V-1 and V-2 weapons of World War II, Scud missiles caused a major diversion of sorties from the air offensive. The Coalition leadership diverted 22 percent of its sorties from strategic targets to eliminate the politically significant Scud missile attacks on Israel and Saudi Arabia, but the mission proved impossible.

The Gulf War demonstrated the vital importance of the U.S. Air Force's Space Command. Organized on September 1, 1982, it provided a first look at what warfare would be like in the twenty-first century. The Air Force began launching satellites of the Navstar Global Positioning System, made famous simply as GPS, in 1973, but GPS was not fully operational until after DESERT STORM. Nonetheless, signals from the constellation of available GPS satellites provided Coalition forces information about Iraqi Scud Missile position, altitude, and velocity with unparalleled accuracy during most hours of the day. DSP satellites furnished early warning of launches, while DSCS satellites ensured secure communications between the Gulf, the United States, and facilities all over the world. These satellite systems were controlled through the Consolidated Space Operations Center at Colorado Springs, Colorado, and the Satellite Control Facility at Sunnyvale, California.

When General Norman Schwarzkopf launched the "100-hour" DESERT STORM ground offensive on February 24, 1991, his forces met little resistance. Air power and total command of the air made possible the maneuver warfare of Schwarzkopf's "Hail Mary"—the employing of American Army and Marine and Arab ground forces in a direct assault on Kuwait while Coalition armored units looped around it to cut off enemy forces retreating into Iraq. Three thousand air sorties that day provided air

support, but found few tactical targets—the air campaign had worked. The greatest threat to ground troops that day was friendly fire. On the first day of the Battle of the Somme in World War I, British casualties amounted to 57,000, including 20,000 killed. On the first day of the Gulf War ground attack, Coalition casualties totaled 14, including 3 killed. Over the next several days the Air Force focused its attention on battering the Republican Guard divisions held in reserve in southern Iraq and interdicting the flood of Iraqi units retreating from Kuwait. The most visible of these efforts was the bottleneck created on the highway northwest out of Kuwait City, in what was called the “highway of death.” The strategic bombing campaign continued through the one hundred hours of the ground offensive, including a last effort to destroy Saddam Hussein’s bunker sanctuaries. Early in the morning of February 28 President Bush and the Coalition unilaterally declared a cease fire. Despite flying 37,567 combat sorties, the Air Force lost only 14 aircraft to hostile action (all from ground fire)—testimony to the professionalism, training, technology, leadership, and doctrine of the post-Vietnam U.S. Air Force.

The Future

With the end of the Cold War, the Air Force adopted a new doctrine—Global Reach-Global Power. Released in June 1990, it prompted the first major Air Force reorganization since March 1946. Under Chief of Staff General Merrill McPeak, Strategic Air Command and Tactical Air Command were deactivated on June 1, 1992. Many of their assets were incorporated into Air Combat Command, headquartered at Langley Air Force Base in Virginia. The new organization represents the “global power” portion of the new Air Force, controlling ICBMs; command, control, communication, and intelligence functions; reconnaissance; tactical airlift and tankers; fighters; and bombers. Air Mobility Command and its in-flight refueling assets headquartered at Scott Air Force Base in Illinois, replaced Military Airlift Command as the “global reach” portion of the Air Force, controlling strategic airlift and tanker forces.

Global Reach-Global Power and a new doctrinal manual issued in March 1992, AFM 1-1, *Basic Aerospace Doctrine of the United States Air Force*, represent an Air Force committed to matching aerial forces with changing circumstances, drawing on nearly 100 years of experience. The Gulf War, like previous wars, demonstrated that the technology, leadership, training, strategy, and tactics employed for a specific set of conditions and circumstances in one war will not necessarily guarantee success

in the next. An innovator behind fighter tactics in the Vietnam War, Colonel Robin Olds, concluded from his own experience that "no one knows exactly what air fighting will be like in the future." The U.S. Air Force proved decisive to victory in World War II and in the Gulf War and to separation from the limited conflicts in Korea and Vietnam. Future conflicts will bring new challenges for air power in the service of the nation.

Suggested Readings

- Air University Air Command and Staff College. *Space Handbook: A War Fighter's Guide to Space*. Maxwell Air Force Base, Ala.: Air University Press, 1993.
- Beck, Alfred M., ed. *With Courage: The U.S. Army Air Forces in World War II*. Washington, D.C.: Air Force History and Museums Program, 1994.
- Burrows, William E. *Deep Black: Space Espionage and National Security*. New York: Random House, 1986.
- Clodfelter, Mark. *The Limits of Air Power: The American Bombing of North Vietnam*. New York: Free Press, 1989.
- Cooling, Benjamin F., ed. *Case Studies in the Achievement of Air Superiority*. Washington, D.C.: Center for Air Force History, 1994.
- , ed. *Case Studies in the Development of Close Air Support*. Washington, D.C.: Office of Air Force History, 1990.
- Copp, DeWitt S. *A Few Great Captains: The Men and Events that Shaped the Development of U.S. Air Power*. Garden City, N.Y.: Doubleday, 1980.
- . *Forged in Fire: Strategy and Decisions in the Air War over Europe, 1940–1945*. Garden City, N.Y.: Doubleday, 1982.
- Craven, Wesley Frank, and James Lea Cate, eds. *The Army Air Forces in World War II*. 7 vols. Chicago: University of Chicago Press, 1948–1955.
- Davis, Richard G. *Carl A. Spaatz and the Air War in Europe*. Washington, D.C.: Center for Air Force History, 1993.
- Douglas, Deborah G. *United States Women in Aviation, 1940–1985*. Washington, D.C.: Smithsonian Institution Press, 1990.
- Futrell, Robert F. *Ideas, Concepts, Doctrine: A History of Basic Training in the United States Air Force, 1907–1964*. Maxwell Air Force Base, Ala.: Air University, 1974.
- . *The United States Air Force in Korea, 1950–1953*. New York: Duell, Sloan and Pearce, 1961.
- Glines, Carroll V., Jr. *The Compact History of the United States Air Force*. New York: Hawthorn Books, 1973.
- Goldberg, Alfred, ed. *A History of the United States Air Force, 1907–1957*. Princeton, N.J.: D. Van Nostrand, 1957.
- Gropman, Alan L. *The Air Force Integrates, 1945–1964*. Washington, D.C.: Office of Air Force History, 1978.
- Gulf War Air Power Survey. *Gulf War Air Power Survey*. 6 vols. Washington, D.C.: Government Printing Office, 1993.
- Hall, R. Cargill, ed. *Case Studies in Strategic Bombardment*. Washington, D.C.: Air Force History and Museums Program, unpublished manuscript.

- Hallion, Richard P. *Rise of the Fighter Aircraft, 1914-1918: Air Combat in World War I*. Annapolis: Nautical and Aviation Publishing Company, 1984.
- . *Storm Over Iraq: Air Power and the Gulf War*. Washington, D.C.: Smithsonian Institution Press, 1992.
- . *Strike from the Sky: The History of Battlefield Air Attack, 1911-1945*. Washington, D.C.: Smithsonian Institution Press, 1989.
- . *Test Pilots: The Frontiersmen of Flight*. Washington, D.C.: Smithsonian Institution Press, 1988.
- Hansell, Haywood S., Jr. *The Strategic Air War against Germany and Japan*. Washington, D.C.: Office of Air Force History, 1986.
- Haydon, Frederick Stansbury. *Aeronautics in the Union and Confederate Armies*. Baltimore: Johns Hopkins University Press, 1941.
- Hennessy, Juliette A. *The United States Army Air Arm, April 1861 to April 1917*. Washington, D.C.: Office of Air Force History, 1985.
- Hudson, James J. *Hostile Skies: A Combat History of the American Air Service in World War I*. Syracuse, N.Y.: Syracuse University Press, 1968.
- Hurley, Alfred F. *Billy Mitchell: Crusader for Air Power*. New York: F. Watts, 1964.
- Kennett, Lee B. *The First Air War, 1914-1918*. New York: Free Press, 1991.
- Kerr, E. Bartlett. *Flames over Tokyo: The U.S. Army Air Forces' Incendiary Campaign Against Japan, 1944-1945*. New York: Donald I. Fine, 1991.
- Mark, Eduard. *Aerial Interdiction in Three Wars*. Washington, D.C.: Center for Air Force History, 1994.
- Maurer, Maurer. *Aviation in the U.S. Army, 1919-1939*. Washington, D.C.: Office of Air Force History, 1987.
- , ed. *The U.S. Air Service in World War I*. 4 vols. Maxwell Air Force Base, Ala.: Simpson Historical Research Center, 1978.
- McFarland, Stephen L. *America's Pursuit of Precision Bombing, 1910-1945*. Washington, D.C.: Smithsonian Institution Press, 1995.
- , and Wesley Phillips Newton. *To Command the Sky: The Battle for Air Superiority over Germany, 1942-1944*. Washington, D.C.: Smithsonian Institution Press, 1991.
- Morrow, John H. *The Great War in the Air: Military Aviation from 1909 to 1921*. Washington, D.C.: Smithsonian Institution Press, 1993.
- Neufeld, Jacob. *The Development of Ballistic Missiles in the United States Air Force, 1945-1960*. Washington, D.C.: Office of Air Force History, 1990.
- Tilford, Earl H. *Crosswinds: The Air Force's Setup in Vietnam*. College Station: Texas A&M University Press, 1993.
- United States Strategic Bombing Survey. *Final Reports of the United States Strategic Bombing Survey*. 325 vols. Washington, D.C.: Government Printing Office, 1945-1947.